



Supercharging Our Electric Vehicle Workforce

A roadmap for unlocking the future of advanced manufacturing



Mike DeWine, Governor

Governor's Office of
Workforce Transformation

Jon Husted, Lt. Governor and Director



Preparing Ohio's Workforce for the Growth of the EV Industry

A letter from Ohio Lt. Governor Jon Husted

Ohio has always been at the forefront of advanced manufacturing, leading in technological innovation and industry transformation. We take pride in our industry-led approaches to driving progress. Now, we have an exceptional opportunity to ensure that our workforce is well-prepared to support the automotive industry in the realm of electric vehicle (EV) manufacturing. The advent of EVs necessitates comprehensive changes to our power grid, workforce, and production systems, and Ohio is poised to play a significant role in meeting these demands and accelerating their adoption across the United States.



According to projections, by 2032, EVs are expected to surpass internal combustion engines (ICE) as the primary mode of transportation, capturing up to 67% of the U.S. sales market share.¹ This holds great significance for Ohio, as we are the largest producer of automotive parts and home to the second-largest automotive workforce in the country. Already, the shift towards electrifying transportation has attracted over \$8 billion in private investments related to EVs throughout Ohio in the past year and a half.²

To fully seize this moment, we must make systematic investments in our EV workforce—the talented Ohioans who will pioneer battery development, assemble new vehicle models, and deploy charging infrastructure. These investments will involve establishing new training pathways and educational programs, expanding existing initiatives, and diversifying our talent pool to accommodate the estimated creation of 25,000 new EV-related jobs by 2030. This is why we have partnered with the Ohio Manufacturers' Association (OMA) to develop an EV-focused workforce development strategy, as outlined in this report.

The creation of this report has been a collaborative effort, engaging industry stakeholders, workforce representatives, and education partners. We look forward to sustaining this partnership as we launch the strategy and embark on initiatives that enable our workforce and Ohio businesses to compete and emerge victorious. We hope that you will find this report both informative and inspiring, and we invite you to join us in shaping and expanding a resilient EV workforce capable of adapting at the speed of innovation, reaffirming Ohio's position as a powerhouse in advanced manufacturing for the 21st-century economy.

A handwritten signature in black ink that reads "Jon Husted". The signature is written in a cursive, flowing style.

Jon Husted
Lt. Governor of Ohio

¹ U.S. EPA (2023), "[News release: Pollution Standards for Cars and Trucks](#)" U.S. EPA (2023), "[Multi-Pollutant Emissions Standards for Model Years 2027 and Later Light-Duty and Medium-Duty Vehicles](#)."

² The Ohio Manufacturers' Association, (2023), "[Retooling Ohio: Major EV-Related Investments in Ohio](#)."

A Prepared EV Workforce Protects and Grows Ohio's Manufacturing Sector

A Letter from The Ohio Manufacturers' Association (OMA)

Manufacturing has been vital to Ohio's economy for the past century. At the OMA – the leading trade association for manufacturers across the state – we strive to keep our sector ahead of and ready for change. In recent years, our members and their partners have devoted tremendous resources to modernizing workforce development. To transform how Ohio cultivates talent, the OMA and manufacturers have together established a statewide system of Industry-led Sector Partnerships (ISPs), advocated for improved training and funding, and promoted “earn-and-learn” models.



The EV transition will cause one of the fastest and deepest retooling of our manufacturing systems – from supply chain production to technical assembly – in our lifetime. EVs present an enormous opportunity for us to stay at the forefront of advanced manufacturing. But, to do so, we need to evolve our talent strategies, partnerships, and training opportunities. That's why we've partnered with the Governor's Office of Workforce Transformation (OWT) and funded this report through our recent Good Jobs Challenge award. In doing so, we aim to provide timely insights to our academic, industry, and employer partners about the scale and pace of EV-driven job growth in Ohio over the coming decade – as well as which skills will be needed and how to provide the right training opportunities to keep pace with evolving competencies and capabilities.

We developed this report with several priorities in mind to protect and grow Ohio's manufacturing sector. Together, we will:

- **Expand and diversify the talent** we recruit and prepare for careers in the EV industry
- Promote a workforce strategy that **serves all Ohioans** – both in our major cities and across the state's regions
- Create awareness about **EVs as a force multiplier** – the rise of our EV industry will raise awareness about the benefits of advanced manufacturing careers more broadly
- **Create enduring incentives** to achieve our talent skilling and scaling ambitions
- **Sustain our momentum** – we know this will be a long-term, iterative, and evolving journey to rewire our economy and industries to meet the energy transition challenges and opportunities of our time
- **Maintain our competitive edge** as a leading manufacturing powerhouse – as we have from the Industrial Revolution and as we will through the Electric Revolution

We look forward to working with our partners at OWT and our statewide network to unlock the promise and potential of talented Ohioans. OMA commits to mobilizing this EV workforce development strategy and roadmap.

A handwritten signature in blue ink, appearing to read "Ryan Augsburger".

Ryan Augsburger
President, OMA



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Executive Summary: Transitioning Our Talent to Meet the Moment

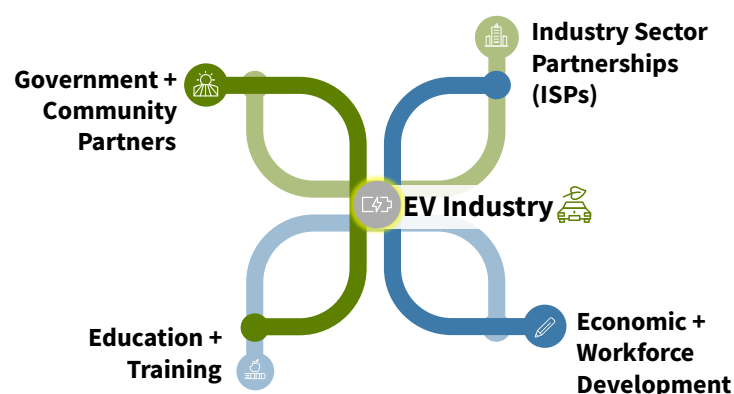
Unprecedented Times. Proven Measures.

The electric vehicle (EV) transition has arrived. With the expected increase in EV adoption and projected dominance of the transportation sector, electrification will redefine supply chains, advanced manufacturing, and mobility – and do so faster and more systematically than previously anticipated. By 2032, EVs will overtake internal combustion engines as the primary modes of transport for new car sales – with up to 67% of market share of U.S. sales.³

25.4k
New EV jobs in Ohio
by 2030

In Ohio, we anticipate more than 25k new jobs will be created by 2030 through a combination of EV manufacturing and maintenance, battery development, and charging station installation and operations. That level of growth, nearly a 30% increase on our current automotive manufacturing sector workforce, will require our industrial and academic sectors to fully recalibrate our learning pathways, scale training and skilling opportunities, and increase this new workforce to power our advanced manufacturing future.

Ohioans already know how to come together. Across organizations and technologies, we build the right coalitions to power scaled outcomes – from broadband and 5G enablement, the Ohio Manufacturers' Association (OMA)'s Industry Sector Partnerships (ISP) for advanced manufacturing, and to the Ohio Semiconductor Collaboration Network.



It is with that spirit of can-do-collaboration that the Governor's Office of Workforce Transformation (OWT) and the OMA convened a broad group of stakeholders in the Winter of 2023 to align on strategies and actions to meet this moment of significant job growth from the EV value chain – including all parts of the electrification of transportation from battery manufacturing to charging station installation.

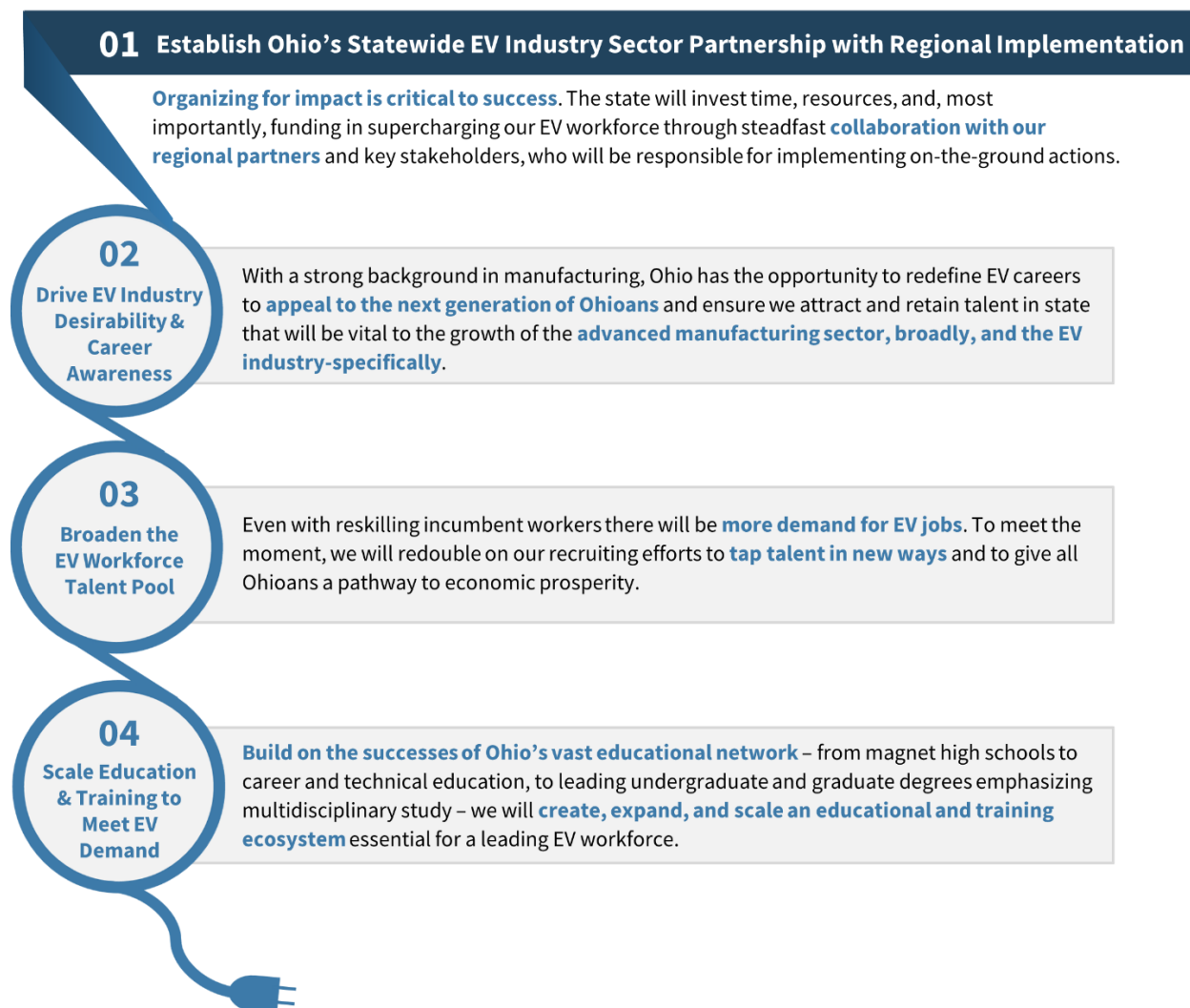
Our representative group spanned across 70+ organizations including industry, government, community, education, training, and workforce development companies, organizations, coalitions, and institutions. Over the course of three months, we aligned on what it would take to tap existing talent, unlock new sources of skills, and prepare Ohio for an electrified transportation future. Along with our consulting partner, Accenture, we estimated the growth trajectory for EV occupations across Ohio through 2030, mapped existing education and training infrastructure, conducted a gap analysis of that infrastructure, and then developed strategies to close those gaps. Those details are found within this report: *Supercharging our EV Workforce | A roadmap for unlocking the future of advanced manufacturing*.

³ U.S. EPA (2023), "[News release: Pollution Standards for Cars and Trucks](#)." U.S. EPA (2023), "[Multi-Pollutant Emissions Standards for Model Years 2027 and Later Light-Duty and Medium-Duty Vehicles](#)."

One Strategy, Four Pillars | Our Plan to Supercharge Our EV Workforce

Our EV workforce development strategy is organized around four pillars, each of which has associated initiatives and actions that will be explored in greater detail below, to address our key motivating statement.

“How might Ohio develop and scale a resilient EV workforce that will evolve at the pace of innovation and make Ohio a modern manufacturing powerhouse?”



While 60 pages, this report is just the beginning. We know that the state will need longer, deeper, and iterative collaboration across our industry and academic partners to fully deliver on the potential of an EV economy. Ohio will begin mobilization in the summer of 2023, and together, we will develop regional EV coalitions, implement and refine our strategies to maximize impact, and steward funding for optimal impact across the great state of Ohio.

Capitalizing On the EV Transition

A New Chapter for State and Industry Leadership

Globally, there are more than 20 million passenger EVs on the road and electrification is spreading rapidly to other segments of transport.⁴

Adoption is projected to accelerate over the next decade by 80%, creating huge opportunities for entrepreneurs and incumbent firms.⁵ Currently, there are more than 1.4 million EVs in the United States, including buses, vans, and trucks,⁶ with nearly 300 million one to three-wheeled EVs in circulation, from scooters to motorcycles.⁷ Consumers and firms are being drawn to better performance, lower operating costs, and other benefits provided by EVs.

The private sector has met that demand with substantial commitments to scale and reshore domestic EV manufacturing. Non-public investments in U.S. EV manufacturing tripled to \$73.6 billion in 2022⁸ and are on pace to grow significantly in the next decade. This momentum will continue, as

incentives to invest have increased with recent expectations that to fully realize tax credits, EV battery components and minerals must be produced in North America or with free-trade partners.⁹ In order to adapt and prepare for this transition, Ohio must maximize this opportunity for the industry so we can compete and create prosperity.

U.S. EV Growth Trajectory Projections (2016-2030)

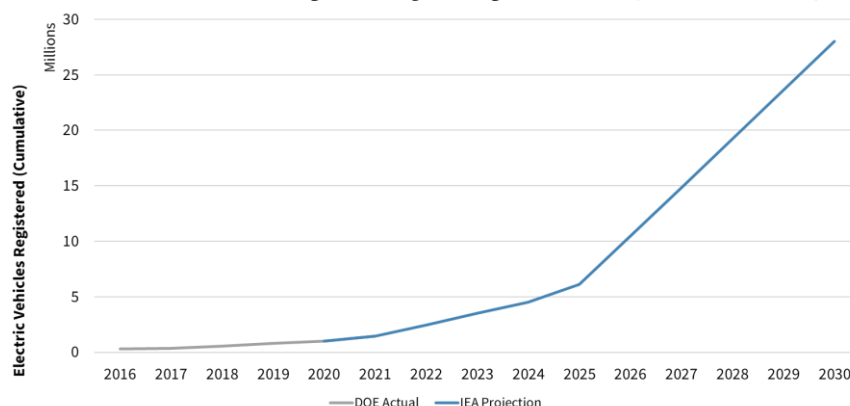


Figure 1: Electric Vehicle Growth

Source: DOE [Advanced Fuels Data Center](#) & IEA APS 2020-2030 EV Stock [Estimates](#) from 2022 Outlook.

Private Sector EV Investments by Year Announced

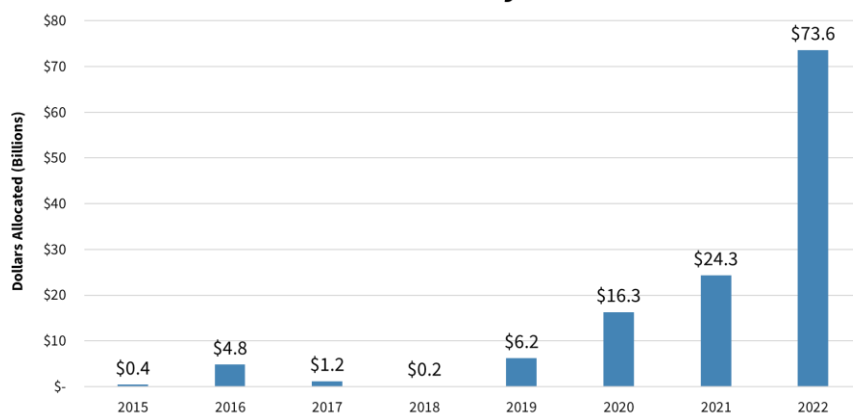


Figure 2: EV Announced Investments in United States

⁴ BloombergNEF (2022), "[Electric Vehicle Outlook 2022](#)."

⁵ Ibid.

⁶ U.S. Department of Energy Alternative Fuels Data Center (2021), "[Electric Vehicles Registered in 2021](#)."

⁷ BloombergNEF (2022), "[Electric Vehicle Outlook 2022](#)."

⁸ Nat Bullard (2023), "[Decarbonization: The long view, trends and transience, net zero](#)." Atlas EV Hub (2023), "[\\$210 Billion of Announced Investments in Electric Vehicle Manufacturing Headed for the U.S.](#)"

⁹ Internal Revenue Service (2023), "[Credits for New Clean Vehicles Purchased in 2023 or After](#)."

Original Equipment Manufacturer (OEM) and Fleet Electrification Commitments*

| OEM PLEDGES | 2025 | 2030 |
|-------------------------|---|--|
| General Motors | 20 EV models All EV by 2025 | Volvo All-EVs |
| Hyundai | All New Vehicles = EVs | Ford ½ EV for global sales |
| BUSINESS PLEDGES | | Stellantis ½ EV for U.S. sales |
| FedEx | 50% EV for parcel delivery fleet | Amazon 100k EVs |
| DHL | 70% clean transport for first & last mile delivery | Duke Energy 100% light-duty vehicles to be electric |
| | | Lime 100% zero-emission fleet vehicles |

*Non-exhaustive

These investments will help deliver on the swifter-than-expected commitments from automakers and fleet operators to shift into fully EV platforms. Most automakers have plans to electrify a significant number of their vehicles by 2030, with some announcing fully electrified fleets within five years. This will be a swift transformation, as EVs were only 5.8% of new car sales in 2022.¹⁰ Many public and private fleet operators are emphasizing EVs for their low operating costs, such as the U.S. Post Office and Amazon. The State of Ohio is ensuring that this future works for Ohioans, planning for \$140 million to be invested in fast charging across the state so that EVs are accessible to all who want them.¹¹

This consumer, fleet operator, and manufacturer uptake has been underpinned by substantial growth in the funding of and investments in EV manufacturing, charging rollout, and transportation electrification in recent years. Combined, there are over \$80.7 billion in eligible grants, rebates, and formula funds for EV, battery, and charging infrastructure development and deployment for Ohioans and businesses to take advantage of from the recent Infrastructure Investment and Jobs Act and Inflation Reduction Act (IRA).¹²

These shifts put Ohio in a unique position to capitalize on historic strengths as the largest automotive parts producer and the second largest automotive assembler, nationally.¹³ In Ohio, we anticipate more than 25k new jobs will be created by 2030 through a combination of EV manufacturing and maintenance, battery development, charging station installation and operations.

Many of those jobs will require re-tooling existing learning and training pathways and a major expansion of education opportunities that start in high schools. We must also broaden beyond traditional post-secondary pathways to have enough talent to meet the demand.

The call to action is clear – make Ohio the best state for EV production in the country. Every state is pursuing electrification investments and courting industry and private market players, as incentives to build and assemble in America are at an all-time high. We know we must lean in with a comprehensive, coordinated approach to establish Ohio's place in the EV economy. Private and public actors seek leadership, a willingness to transition, and material commitments to building the physical and workforce infrastructure needed to pivot to new transportation and production systems. States who do not will be left behind – as cash and capital will flow to those that have plans to unlock the trillions in value and the millions of jobs anticipated in the coming decade.

Select IIJA & IRA EV-Related Funds

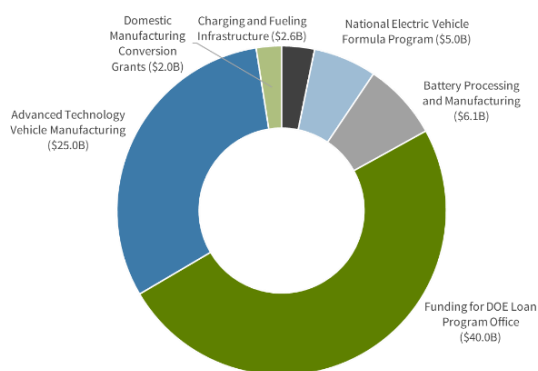


Figure 3: Source of Federal Funds

Source: Atlas Public Policy analysis [Table 1](#); exclusive of 'Credit' / 'Multiple' programs

¹⁰ Kelly Blue Book (2023), "New Car Sales Fell in 2022, but New Electric Car Sales Rose Dramatically."

¹¹ DriveOhio (2023), "National Electric Vehicle Infrastructure Formula Program (NEVI)."

¹² Atlas EV Hub (2023), "\$210 Billion of Announced Investments in Electric Vehicles Manufacturing Headed for the U.S."

¹³ DriveOhio (2021), "Freight Electrification."

Supercharging our EV Workforce | A roadmap for unlocking the future of advanced manufacturing

We know this won't be easy. The roll out of EV infrastructure has been likened to the complexities of creating a new interstate highway system in a much shorter timeframe. That's why we convened our industry, academic, and public partners in the Winter of 2023 to develop a workforce strategy – *Supercharging our EV Workforce | A roadmap for unlocking the future of advanced manufacturing* – to prepare Ohioans for the EV transition.

“

This industry growth presents an opportunity for my generation and generations to come. I didn't know what I wanted to do before working here but I've never felt so at home. I love the technology and where we are going. I'm making history at this place.

”

– Production Supervisor, Ultium Cells

We are focused on existing and emerging EV occupations across research and development, manufacturing, operations, and maintenance to identify areas of focus relevant to Ohio's present and future economy. The below graphic highlights where we concentrated our labor analysis from a vertical function (e.g., manufacturing) and a horizontal process lens (i.e., batteries, powertrains, and electric vehicle supply equipment [EVSE]). Responsible entities for these processes and functions are noted in light gray (e.g., Tier 1), who also represent current and future employers of EV-related jobs.

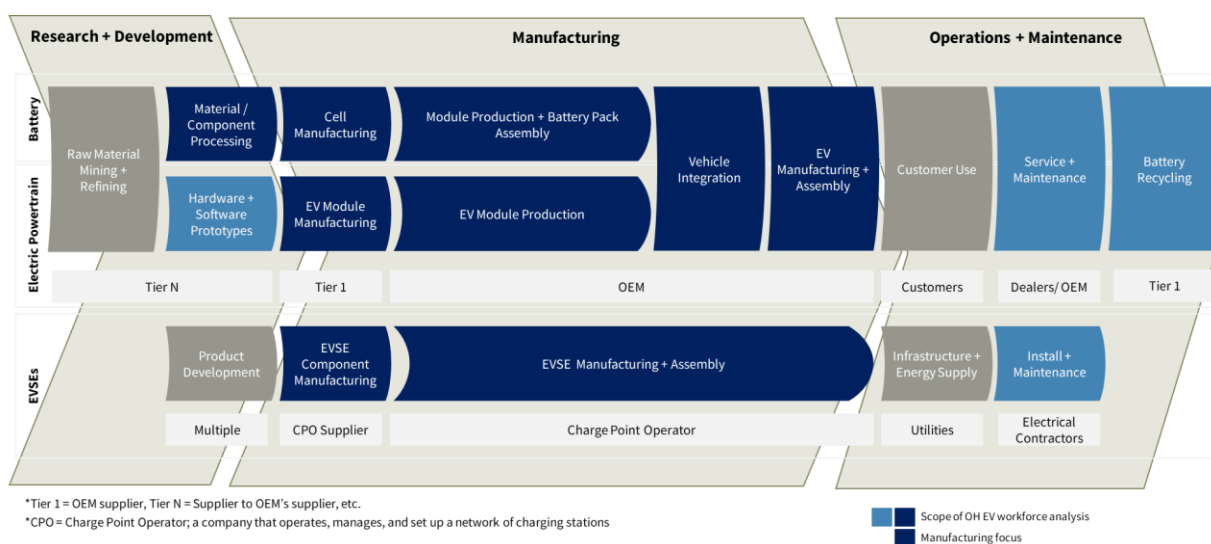


Figure 4: Overview of the EV, EVSE, and Battery Value Chain

These jobs are critical to cementing Ohio's leadership in EV manufacturing in the coming decades. Sectors across government, industry, education, and community partners stand to benefit from the forthcoming workforce expansion.

Strategy Development Process

Who Should Read This Report

Supercharging our EV Workforce | A roadmap for unlocking the future of advanced manufacturing is written for public and private employers, education and skilling partners, workforce and community development partners, and investors interested in rapidly and materially expanding the EV, EVSE, and battery talent supply in Ohio. The report provides a baseline for existing training programs, current labor, projected job growth, and strategies to close gaps and scale talent pipelines in a way that positions Ohio to lead the nation in EV workforce growth and infrastructure.

Data-Driven, Coalition-Informed, Co-Creative Approach

The Ohio EV Workforce Strategy was sponsored by the OWT and the OMA and powered by Accenture, who conducted labor market analysis and facilitated the strategy development process. This report was developed based on data science, labor market research, and on-the-ground realities learned by working closely with Ohio's public and private partner network across the state's evolving Ohio EV Workforce Ecosystem. The [stakeholder groups](#) broadly include:



Over a 10-week period, more than 25 stakeholder sessions were conducted to identify key workforce challenges related to the EV industry and to solicit feedback on priority occupations for EV growth and gap-closing strategies. The central challenge around which we organized was **“How might Ohio develop and scale a resilient EV workforce that will evolve at the pace of innovation and make Ohio a modern manufacturing powerhouse?”**

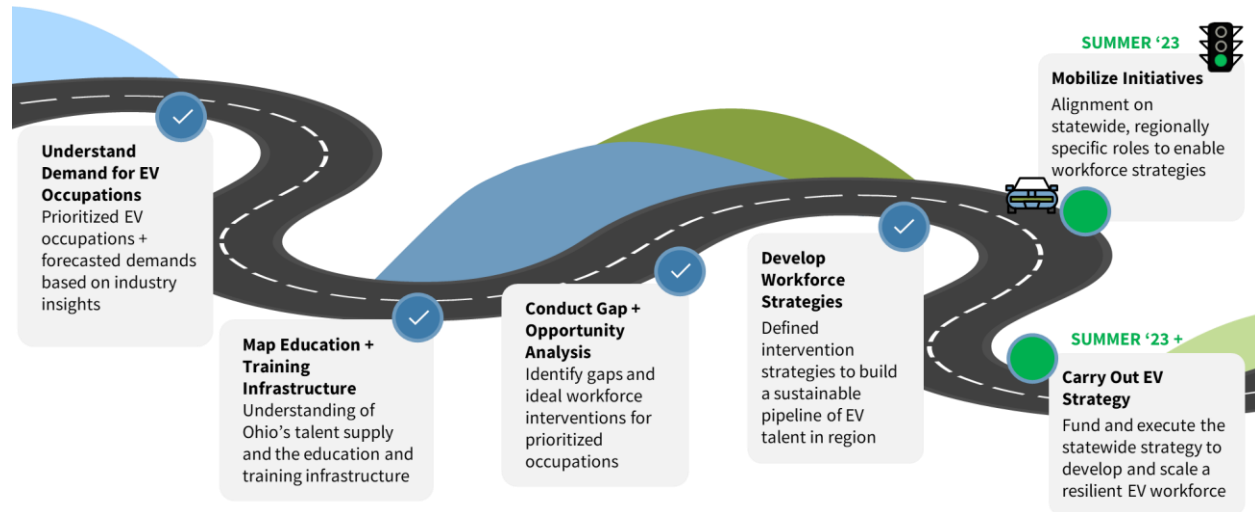
This question was answered through labor market analysis, research, and stakeholder feedback. The quantitative labor market analysis included work to:

- Develop an industry-informed occupation list,
- Identify core competencies and mastery levels per occupation,
- Create a demand projection model and a data-informed supply map, and
- Inventory key education and training programs across the state.

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EV-aligned program completions across each level of the Ohio education and training system were analyzed at an annual production level to derive an initial gap analysis. This quantitative part of the project created a foundational bedrock that fed subsequent project phases.

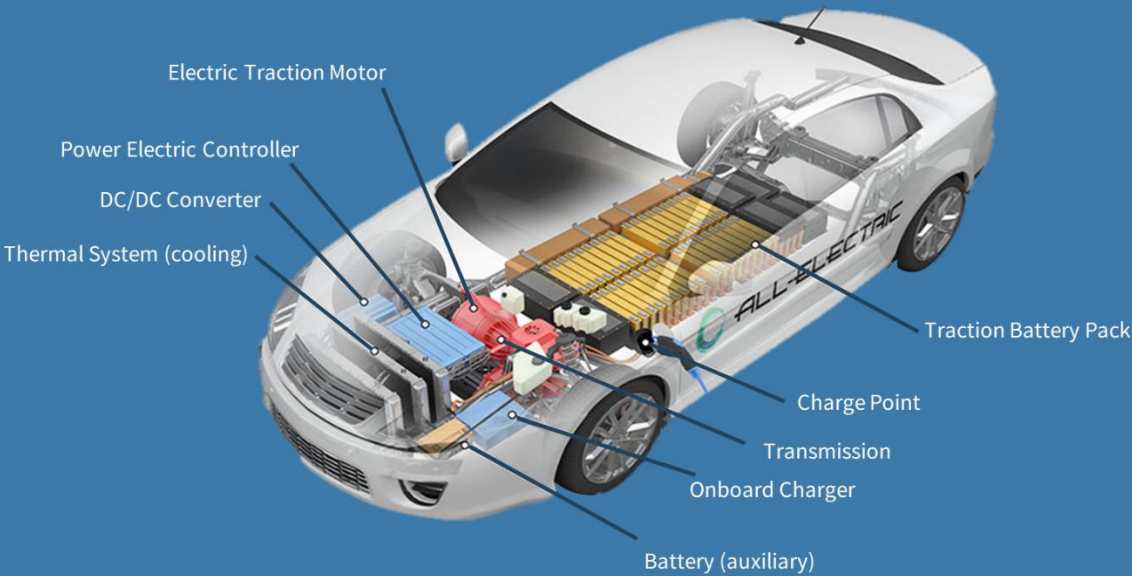
The other part of the central challenge question was answered by forming an Ohio EV Workforce Leadership Team. This team, established within the larger group of 70+ stakeholder organizations, spanned 28 organizations, and engaged in opportunity assessment and strategic design workshop sessions. Within these workshops, stakeholders expanded, challenged, validated, and refined strategies that were then prioritized for action. These strategies will be mobilized over the coming months for implementation.



Educational Callout | Differences Between ICE and Electric Vehicles

An EV-supportive transportation system will require different supply chains, talent, and infrastructure. This includes new kinds of parts, fewer parts, different maintenance needs, new power infrastructure, and changing consumer cost curves. While internal combustion engine (ICE) vehicles can have over 2k moving parts, an EV has around 20, which will shift the focus from hardware to software and services to create a differentiated experience.¹⁴

| ICE Vehicle Component | EV Component |
|---------------------------------|---------------------------------|
| Internal Combustion Engine | Electric Motor |
| Gasoline Fuel Tank | High Voltage Battery |
| Alternator | DC/DC Converter |
| Hydraulic Power Assist Steering | Electric Power Assist Steering |
| No Equivalent | Battery Management System (BMS) |
| No Equivalent | On-board Charger |



Vehicle Image Source: afdc.energy.gov

The presence of a battery is the most notable difference between an EV and an ICE vehicle; however, EVs have other distinct modules and drive train components that – together with the battery – make up the electric powertrain.

¹⁴ Accenture (2023), “[eMobility Value Chain](#)”

EV Workforce Trendlines: Demand and Supply

Understanding the EV Value Chain

High-voltage batteries are the beating hearts of EVs and the most notable difference between them and their ICE counterparts. There are also a host of other unique-to-EV modules (e.g., battery management system, on-board charger, electric motor, DC/DC converter) which comprise the powertrain. Electric Vehicle Supply Equipment (EVSE), colloquially known as chargers, serve as power conduits from EVs to the grid. Each of these components require new methods and processes for manufacturing – and each will require new training, skilling, and/or upskilling of existing and new employees. It will be essential for employers to understand where and how they need to retool their existing trainings and close skills gaps through new EV-focused talent strategies.

Battery, EV and EVSE Value Chain

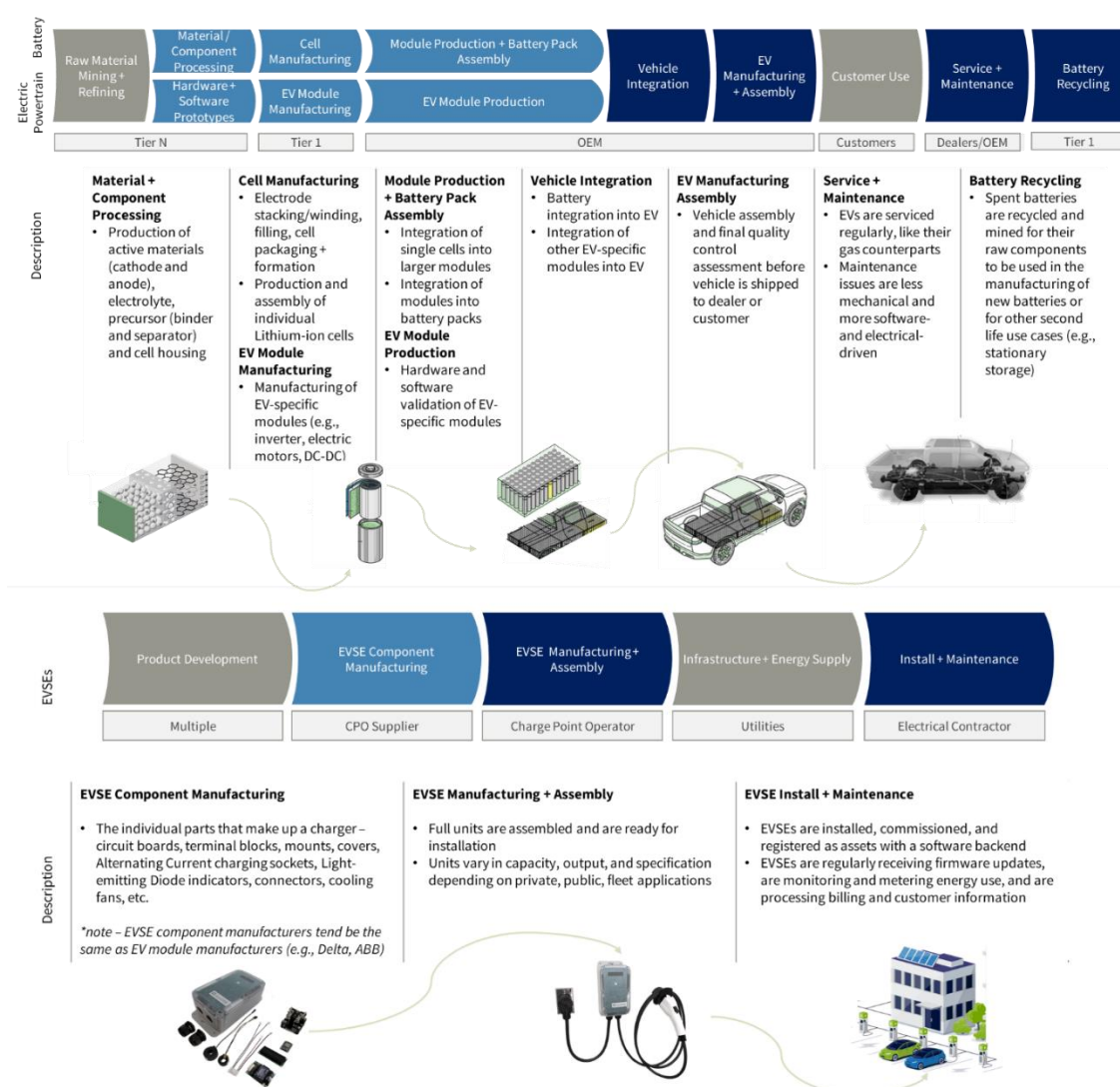


Image Sources: [ResearchGate](#), [OpenEVSE](#), [FacilitiesNet](#)

Figure 5: Battery, EV, and EVSE Value Chain Details

In-Demand Occupations

To understand the EV workforce and skilling needs, we started with a deep inspection of the jobs most associated with the Battery, EV, and EVSE value chain. We then mapped which jobs overlapped with advanced manufacturing as well as their respective entry-level educational requirements.

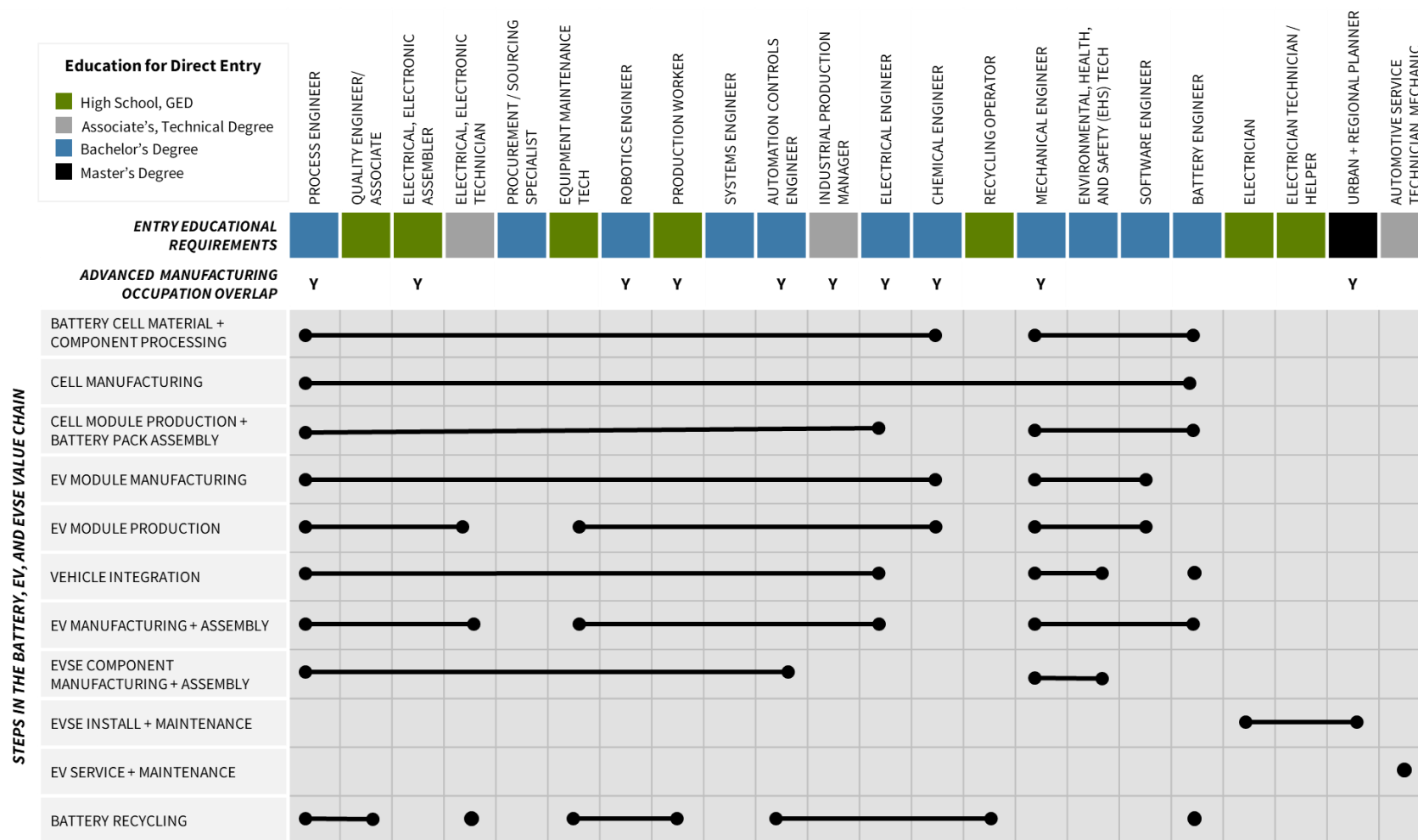


Figure 6: Occupations Across the EV, EVSE, and Battery Value Chain

The “EV Occupations” (Figure 6) table shows how a single occupation (e.g., Equipment Maintenance Technician) is required for multiple value chain steps (e.g., both for Battery Cell Manufacturing and for EV Module Production). The left-hand y-axis shows each step in the battery, EV, or EVSE value chain process. Relevant occupations are listed across the top of the x-axis (a fuller list of EV and adjacent occupations can be found in [Appendix C](#)). Not unlike the ICE automotive value chain, many of the operator, technician, and engineering occupations are dominant in the manufacturing of batteries and EVs, while electricians and vehicle mechanics dominate downstream after chargers and vehicles are in market. Perhaps unsurprisingly, there are a few occupations, like Robotics Engineers, that will be needed throughout the value chain. Other occupations are more concentrated at specific steps in the value chain, like an Electrician Technician who performs field work such as commissioning, servicing, and repairing EVSEs once they are operational.

22 In-Demand EV Occupations

In total, we identified 22 EV, battery, and EVSE-related occupations that are key in the electrification value chain. These 22 occupations have varying entry-level requirements, career pathways, and career trajectories, indicating that the industry includes all skill levels (advanced, skilled assembly, hourly) and across each portion of the EV value chain.

Growing Job Demand

Ohio is quickly building a strong domestic electrification industry, and recent investments in the state, topping nearly \$10 billion, signal our rise as a global hub of EV innovation and manufacturing. The Honda and LG Energy Solution battery plant in Fayette County will alone create 2.2k new jobs. Ford’s new EV manufacturing plant in Lorain County will add an additional 1.8k, and SEMCORP’s new separator film, a key component in LiB’s, facility will bring another 1.2k jobs. Through these investments, combined with pending federal funding and bespoke demand models, it’s estimated that roughly 25.4k new jobs will be created in Ohio by 2030 from EV, battery, EVSE manufacturing, EV maintenance, and EVSE installation and operations.¹⁵

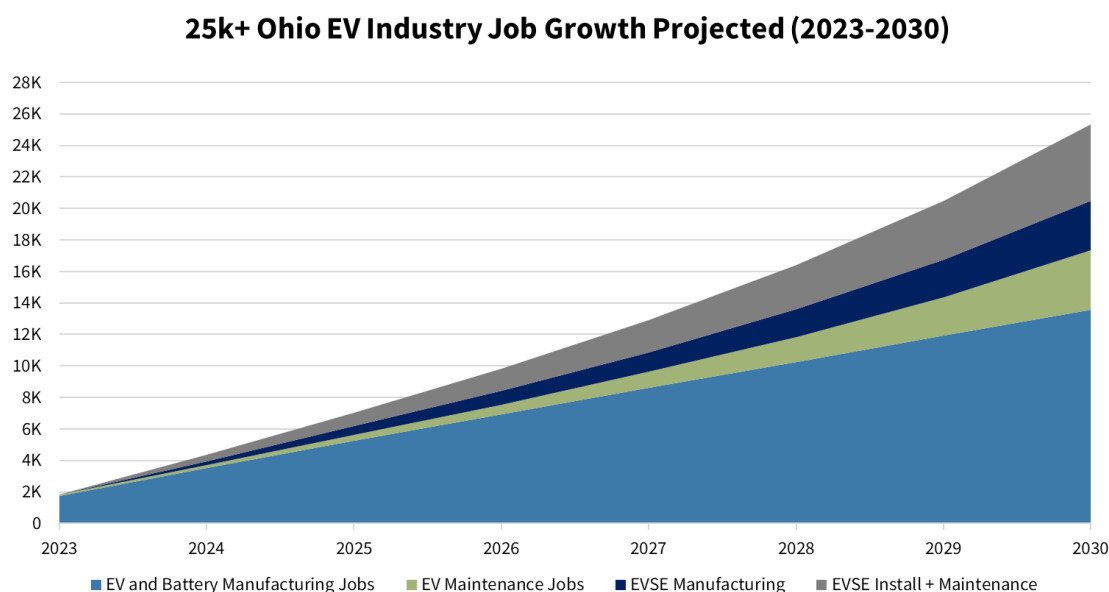
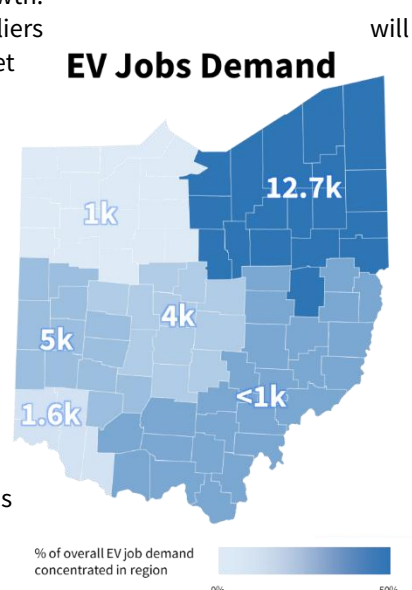


Figure 7: EV Industry Projected Job Growth

¹⁵ This estimate is directional and approximate as there is currently no recognized model to project Ohio-specific growth and workforce estimates in this industry

This is based on information available in Spring 2023 related to Ohio’s EV growth trajectory, and it will be updated as more EV occupations grow to reflect the changing industry growth. As states continue to compete for EV industry share, automakers and suppliers build new, retool existing, and expand current facilities which will adjust net new job creation figures. Immediate job growth will occur in the EV and battery manufacturing space as recent federal and private investment commitments materialize. We expect EVSE maintenance to rapidly grow as a source of job creation as Ohio mobilizes its National Electric Vehicle Infrastructure (NEVI) plan and customers look to EVSEs to be as available, reliable, and ubiquitous as gas stations. Organizations such as DriveOhio are mobilizing EV and EVSE workforce development programs focused on job training and certification as a result of the [Ohio NEVI Plan](#). Many of the EVSE install and maintenance jobs will be clustered along the major highways cutting across the middle and northeast parts of the state along interstate 71 and 77 in accordance with Ohio’s NEVI plan. We anticipate job demand will vary across regions, with the northeast being the most dominant in the foreseeable future. Those regions with lower demand will either supply talent to other parts of the state or will supply talent to non-EV advanced manufacturing jobs locally.

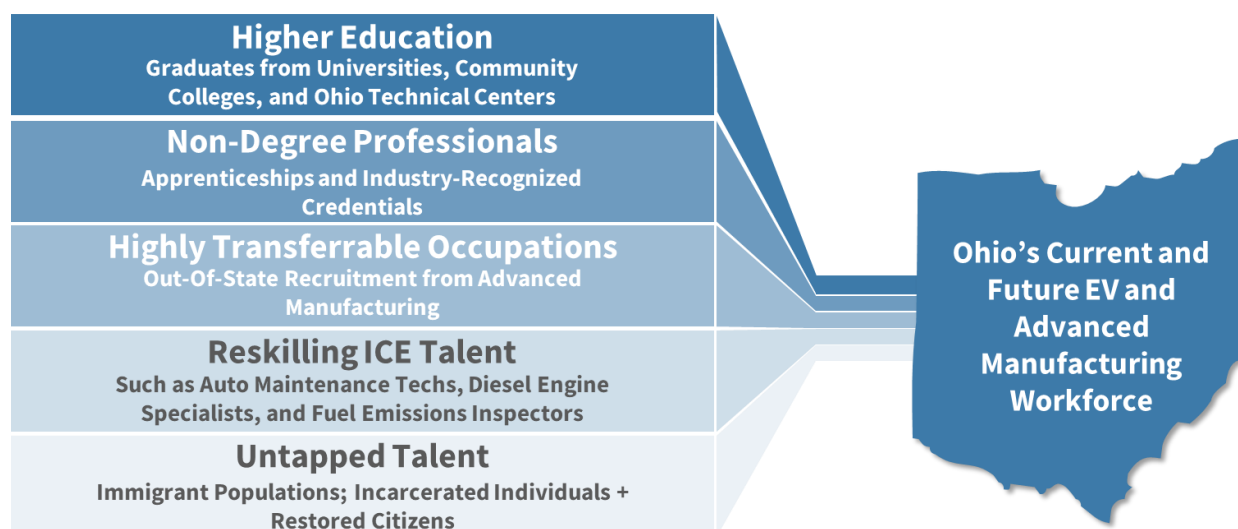


EV Talent Supply Across Ohio

Ohio has numerous channels to tap for EVs from its existing advanced manufacturing workforce development infrastructure and relationships. Below we’ve illustrated the mix of current and future “supply sources” that will be needed to power the future EV workforce across our state and regions. We developed this list – from classic higher education to “untapped talent”¹⁶ and from traditional (4-year-degree programs) to non-traditional certificate programs. From our as-is baseline, we then identified the talent supply gaps we anticipate from the expected 25.4k new jobs by 2030 and provided a set of recommendations (below) for closing them.

Figure 8: Summary of EV Job Demand per Region

Ohio’s Current and Future Talent Supply Sources



¹⁶ Accenture (2021), “[Hidden Workers, Untapped Talent](#).”

With respect to the talent supply assessment, we identified EV-relevant programs at postgraduate, four-, two- and less-than-two-year certificate levels in 117 different subject areas related to the 22 EV occupations. We then assessed how many students were graduating with some level of exposure to these subjects or with EV-relevant degrees or certifications. Below we detail our findings across each of the above sources: Higher Education, Non-Degree Professionals, Highly Transferrable Occupations, Reskilling ICE Talent, and Untapped Talent.

Higher Education

In 2021 (the most recent year for which we have data), 25,358 students graduated from Ohio community colleges, universities, and Ohio Technical Centers (OTCs) with a degree or major mapped to one of our identified EV occupations.¹⁷

Four-year universities made up most graduates, at ~19k, with community colleges coming in at ~6k and OTCs supporting a tiny fraction of graduates at ~200. We anticipate a significant need in growth for the latter two channels – given many new EV jobs will not require a 2- or 4-year degree for entry-level opportunities.

Ohio's higher education system is a path to EV job opportunity, and there are opportunities (and needs) to widen talent pipelines. Of the 2021 data set, 23% of graduates from these higher ed EV-relevant programs were racially/ethnically diverse and 33% were women. Ohio institutions can bolster headcounts and broaden the talent pool by recruiting from these untapped groups.¹⁸

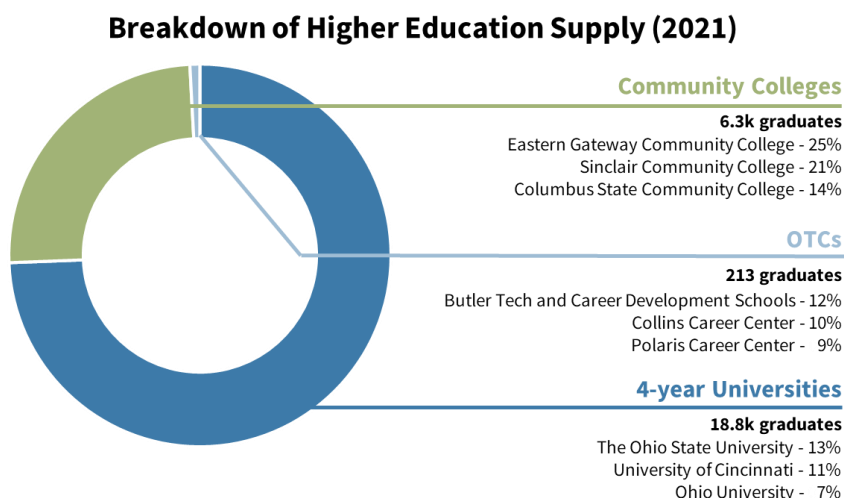
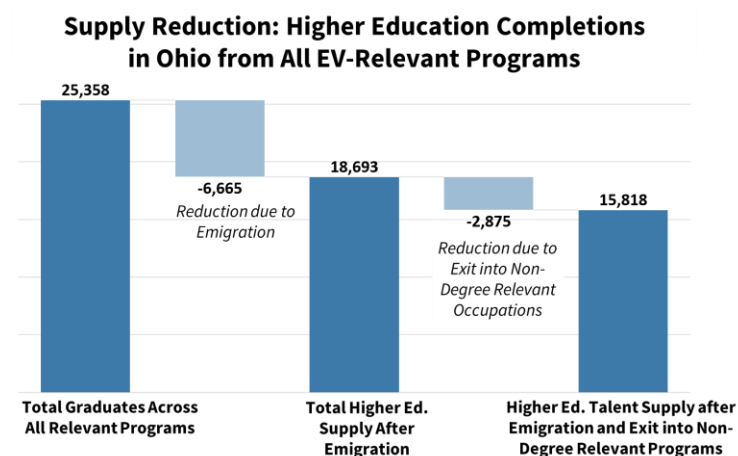


Figure 9: Higher Education Annual Completions (2021-2022)



Additional opportunities for improvement exist in the higher ed-EV space. Like other Midwestern states, Ohio faces a graduate emigration challenge – with talented Ohioans leaving the state for opportunities elsewhere. Ohio is losing college graduates 2.2% more quickly than it draws them in.¹⁹ Of the 2021 EV graduates we tracked, we estimate that roughly 6.6k left the state upon graduation. Moreover, of those that

¹⁷ Emsi Burning Glass (now Lightcast) (2023), "[Full School Listing](#)," Lightcast – lightcast.io. This figure exclude institutions that are not OTCs, CCs, and four-year institutions. Including these other institutions, the total completions number in Ohio is 25,629 in 2021.

¹⁸ Emsi Burning Glass (now Lightcast) (2023), "[Full School Listing](#)," Lightcast – lightcast.io.

¹⁹ Ohio Chamber of Commerce (2022), "[Blueprint for Ohio's Future](#)."

did stay, we estimate ~3k of them chose non-EV occupations.²⁰

Our workforce development strategy addresses all three of these challenges. Ohio will expand its EV workforce by targeting a broader mix of learners and future workers and branding Ohio as a magnet for deep and enduring career growth and opportunity.

Figure 10: EV-Relevant Higher Education Completions in Ohio

Non-Degree Professionals

Many EV career pathways will require only industry-recognized credentials and apprenticeships (vs. degrees) for placement. Just shy of half of the identified in-demand EV occupations do not require a 4-year degree for entry. In 2021, Ohio had 20,161 completions of industry-recognized credentials that were EV-relevant. Of those, around 17.6k were “EV-relevant” with the remaining 2.5k deemed “EV-hirable”, the latter putting a candidate in a competitive position for placement.²¹

EV Industry-Recognized Credentials Top Completions



Figure 11: Top Completions for EV-Hirable and EV-Relevant Credentials

Apprenticeships will also be an important component of both the EV and EVSE manufacturing, installation, and maintenance workforce. Ohio had 772 graduates from apprenticeship programs that mapped to an EV occupation in 2022.²² Most of these were electrician-related programs – a field in major demand and growing shortages as electrification of end uses (like vehicles) surges.

We’ll need to focus on both non-degree approaches to source EV talent, as well as how to thoughtfully accelerate apprenticeship durations – which can start at 40% of their exit salary and often take multiple years before full salaries are accessible.²³ For more information about apprenticeship opportunities in Ohio, visit apprentice.ohio.gov. See [Appendix B](#) for the full list of Ohio training providers with programs relevant to EV.

2022 Apprenticeship Programs

772 EV-Relevant Completions

| | | |
|-------|---|-----|
| 01 | Electrician | 664 |
| 02 | Equipment Maintenance Technician* | 32 |
| 03 | Software Engineer* | 28 |
| 04 | Production Worker* | 16 |
| 05 | Electrician Technician / Electrician Helper | 16 |
| 06 | Mechanical Engineer | 7 |
| 07 | Quality Engineer / Quality Associate | 4 |
| 08 | Robotics Engineer | 4 |
| 09 | Electrical and Electronic Engineering Technologists + Technicians | 1 |
| Total | | 772 |

Figure 12: Top Completions for EV-Relevant Apprenticeship Programs

²⁰ Reduction due to emigration from Ohio was calculated using 2011-2020 PSEO data and Lightcast Profile Analytics Data (2023) to determine the number of graduates leaving Ohio. Reduction due to exits into non-degree relevant occupations was calculated using the same methodology with 2019 ACS and ASEE data. U.S. Census Bureau (2023), “[Post-Secondary Employment Outcomes](#).” Emsi Burning Glass (now Lightcast) (2023), “[Profile Analytics](#)” Lightcast – lightcast.io. U.S. Census Bureau (2023), “[American Community Survey Data](#).” American Society for Engineering Education (2023), “[Survey: Most Engineers Work in Jobs Related to their Degree](#).”

²¹ 2021 Industry-Recognized Credentials data from the Ohio Department of Education.

²² RAPIDS data from Apprentice Ohio & ODJFS; U.S. Department of Labor (2023), “[Explore Approved Occupations for Registered Apprenticeships](#).”

²³ Urban Institute (2021), “[Setting Wages in Your Registered Apprenticeship Program](#)”

Highly Transferrable Occupations

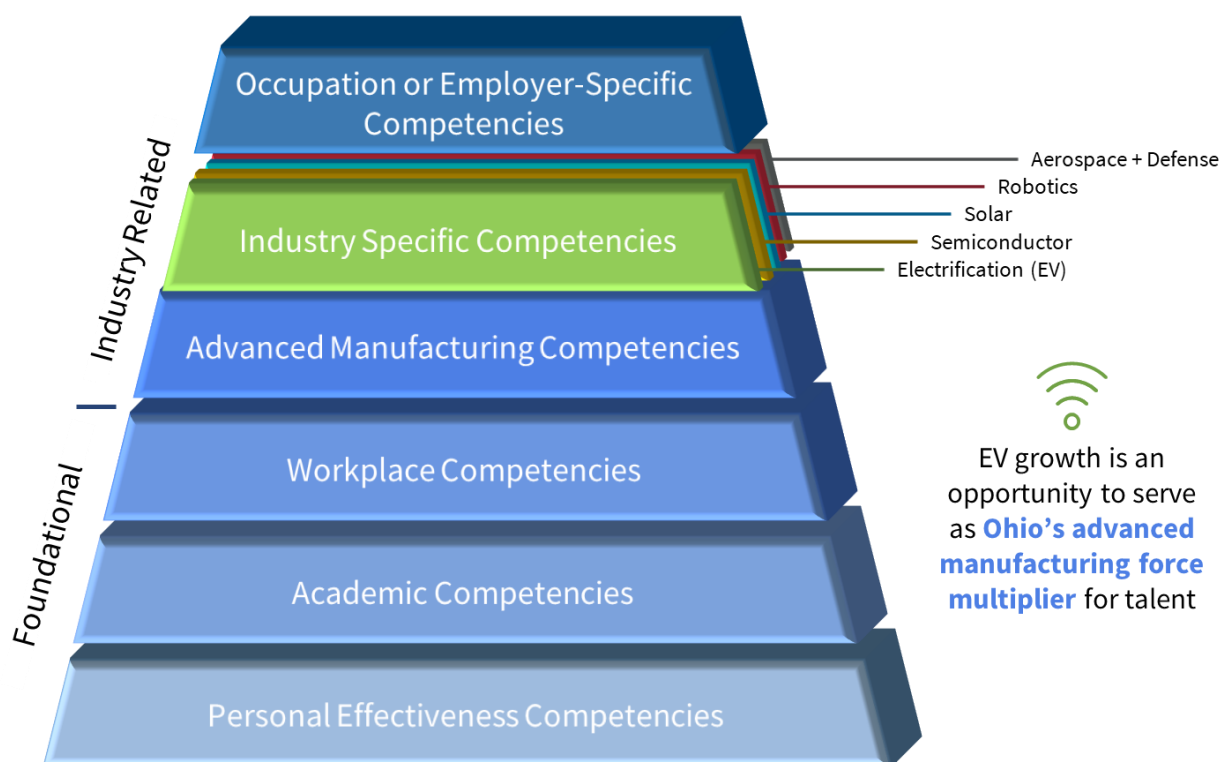
We have also included the recruitment of talent in related advanced manufacturing industries as an additional supply lever. There is a large degree of skill and competency overlap among advanced manufacturing industries that relate to core competencies required for the EV industry (see *Educational Callout: Ohio's Opportunities to Grow Together*).

Out-of-state talent from related industries could not only bolster EV talent pipelines, but also fill occupations related to other major manufacturing projects in the state, such as Intel's 3k new jobs with its Licking County mega site, ZIN Technologies' 125 new jobs for its aerospace facility expansion in Northeast Ohio, and Abbott's 450 new jobs for its baby formula plant in Northwest Ohio.

“You've built your quality skills; you've built your manufacturing skills...and those will be critical as we transition to new factory environments and technology. Applying that knowledge to a new product and new equipment is key to success.”

– Manufacturing Lead, Honda

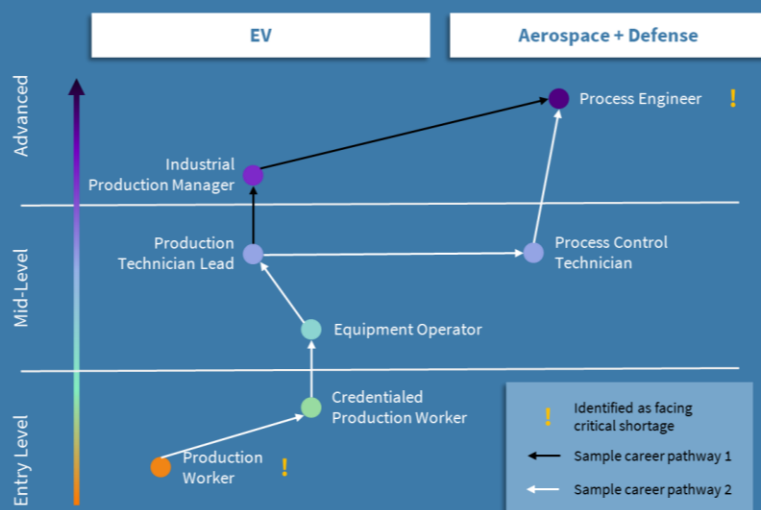
Building Blocks of an Advanced Manufacturing Competency Model



Educational Callout | Ohio's Opportunities to Grow Together

Many in-demand EV occupations are shared across advanced manufacturing industries, like the semiconductor and aerospace and defense industries. The advanced manufacturing sector has shared foundational competencies that can be parlayed into new career paths, as shown below. Individuals who pursue these

Sample Career Pathway – Production Worker to Process Engineer

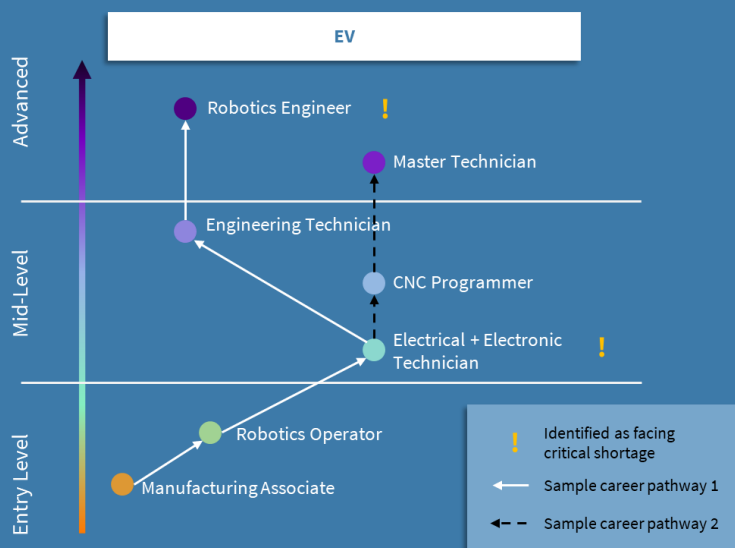


shared-sector occupations have immense job security, employment prospects, and relevant skills that allow them to flex in and out of industries throughout their career.

As shown in the “Building Blocks of an Advanced Manufacturing Competency Model” figure, the foundational building blocks within advanced manufacturing competencies are shared among industries. Referred to collectively as ‘advanced manufacturing competencies’, their applicability to roles throughout the sector opens doors to dozens of possible career paths. The full list of competencies within each tier can be found in [Appendix D](#).

There are many ways to pursue evolving interests or new opportunities in the EV, battery, and EVSE industries. There are as many career pathways as there are employees. Sample career pathways reflected are intended to suggest affinity and possibility. They are illustrative of some of the more common ways people can navigate their careers through internal and external pathways, flexing in and out of the EV industry due to its

Sample EV Internal Career Pathway – Electrical & Electronic Technician to Robotics Engineer



foundational competencies with in-kind industries. Employers and employees alike should view electrification not through a narrow, single-occupation lens, but as foundational for creating a skilled, next generation workforce with multiple lateral career options in similar skilled industries and horizontal career options in other advanced manufacturing roles.

The top image depicts two sample career pathways for a Production Worker and a Process Engineer. Here, with cross-transferrable skills, EV candidates can flex into other advanced manufacturing industries (e.g., aerospace + defense, solar).

Reskilling Internal Combustion Engine (ICE) Talent

There are more than 37k²⁴ individuals in Ohio working in roles that are primarily relevant to internal combustion engine vehicles. These individuals can be skilled to transition into EV roles due to high transferability between their skills and competencies and the skills and competencies required in related EV jobs. The figure below demonstrates the competency overlap between an at-risk occupation – a Fuel Emissions Inspector – and an in-demand EV occupation – a Quality Inspector. The high degree of competency overlap indicates foundational skills required for EV-related work do not lie outside the range of foundational skills required for ICE vehicles (see also *Education Callout: Ohio's Opportunities to Grow Together*).

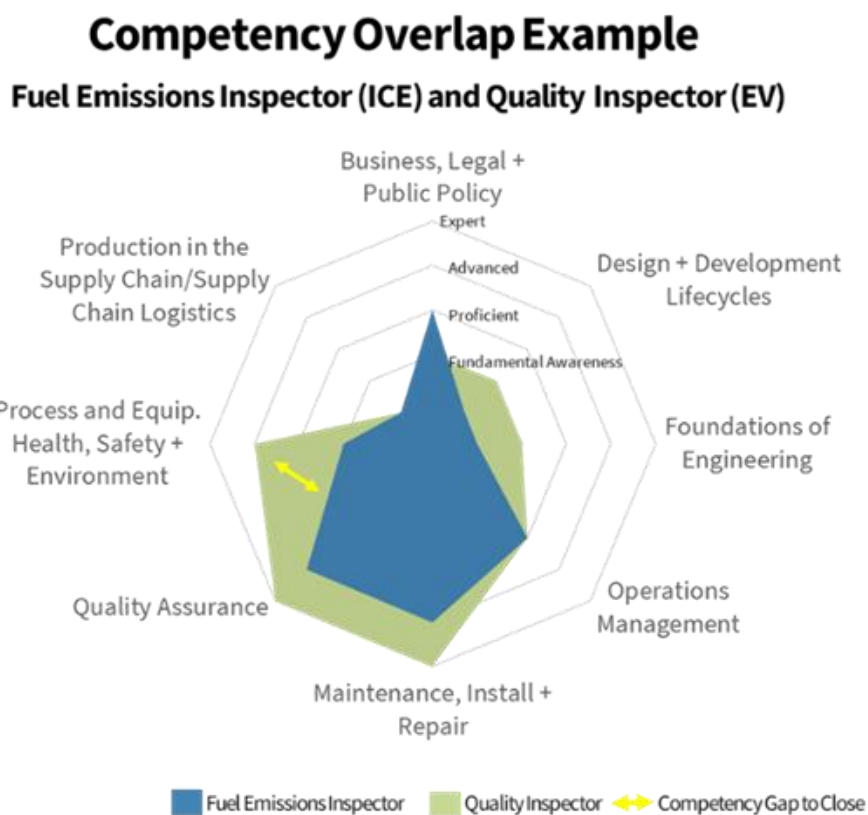


Figure 13: Sample ICE to EV Occupation Competency Model Overlap

Further, two studies²⁵ examining 252 ICE and EV powertrain manufacturing processes found that EV powertrain manufacturing requires a greater percentage of labor hours than ICE powertrains largely because of the battery pack manufacturing requirements, and while EVs contain less parts, there are more tasks and steps involved in the EV manufacturing process, which dispels the myth that EVs will create job loss because they have less parts and will require less labor. While they do contain less parts, EVs require additional steps in the production of batteries and power electronics that will require more labor than ICEs. Indeed, it is not the number of parts but rather the process steps, their cycle times, and labor hours per part, that determine the skills and hours required for EV assembly.

²⁴ Emsi Burning Glass (now Lightcast) (2023), "Occupation Snapshot." Lightcast – lightcast.io

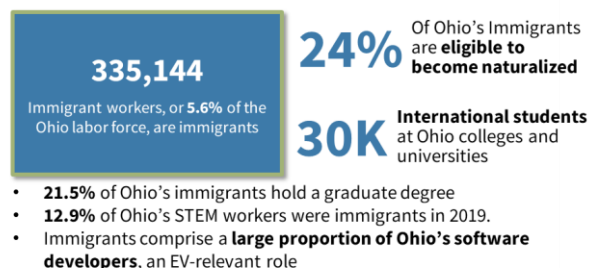
²⁵ Cotterman, Turner and Fuchs, Erica Renee and Whitefoot, Kate (June 4, 2022), "[The transition to electrified vehicles: Evaluating the labor demand of manufacturing convention versus battery electric vehicle powertrains](#)." Cotterman, Turner (May 2022), "[Technology transitions in the electricity and automotive sectors: Embracing political, social, and economic constraints](#)."

Untapped Talent

Research from Accenture and the Harvard Business School’s “Project on Managing the Future of Work” explores the phenomenon of “hidden workers” which are millions of people who are eager to work and possess—or could develop—the skills employers seek, if only those employers could find them. Ohio can widen the supply of talent available for advanced manufacturing, as well as EV by thinking differently about its talent pools and finding these hidden workers.

An example is Ohio’s vibrant immigrant population, which comprises nearly 6% of the state’s labor force, but comprises 12.9% of the state’s STEM workers. About a quarter of Ohio’s immigrant population are eligible to be naturalized and there is a large population of international students attending Ohio’s college, 30k students in 2019.²⁶

Ohio Immigrant Population Overview



Top Occupations with the Highest Share % Share of Immigrant of Immigrant Workers Workers

| | |
|-----------------------------|-------|
| Packers and packagers, hand | 27.6% |
| Physicians | 24.7% |
| Software developers | 23.4% |
| Postsecondary teachers | 23.1% |

23.4% of Ohio’s software developers, an EV-relevant occupation, are also immigrants.

Another example of nontraditional talent OEMs and Tier 1s we could look to are currently incarcerated individuals and restored citizens, many of whom received or are receiving training in EV-relevant and EV-hirable areas from correctional institutions. The data below showcases the EV-relevant and EV-hirable apprenticeship programs offered by Ohio Correctional Institutions as of March 2023.²⁷ Many of the EV-relevant and EV-hirable programs, such as electrical maintenance, quality control inspector, and maintenance repairers, are pervasive throughout the EV value chain.²⁸

Ohio Currently Incarcerated Individuals & Restored Citizen Programs Overview



53 EV-Relevant Programs offered

65 EV-Hirable Programs offered

| Top 5 EV-Hirable Programs Offered | # of Programs | All EV-Relevant Programs Offered | # of Programs |
|-----------------------------------|---------------|----------------------------------|---------------|
| Electrical Maintenance | 15 | Maintenance Repairer, Building | 23 |
| Welder, Combination | 9 | Recovery Operator | 21 |
| Quality Control Inspector | 5 | Auto Mechanic | 6 |
| Machine Operator | 5 | Powerhouse Mechanic | 2 |
| Welder, Fitter | 5 | Small Engine Mechanic | 1 |

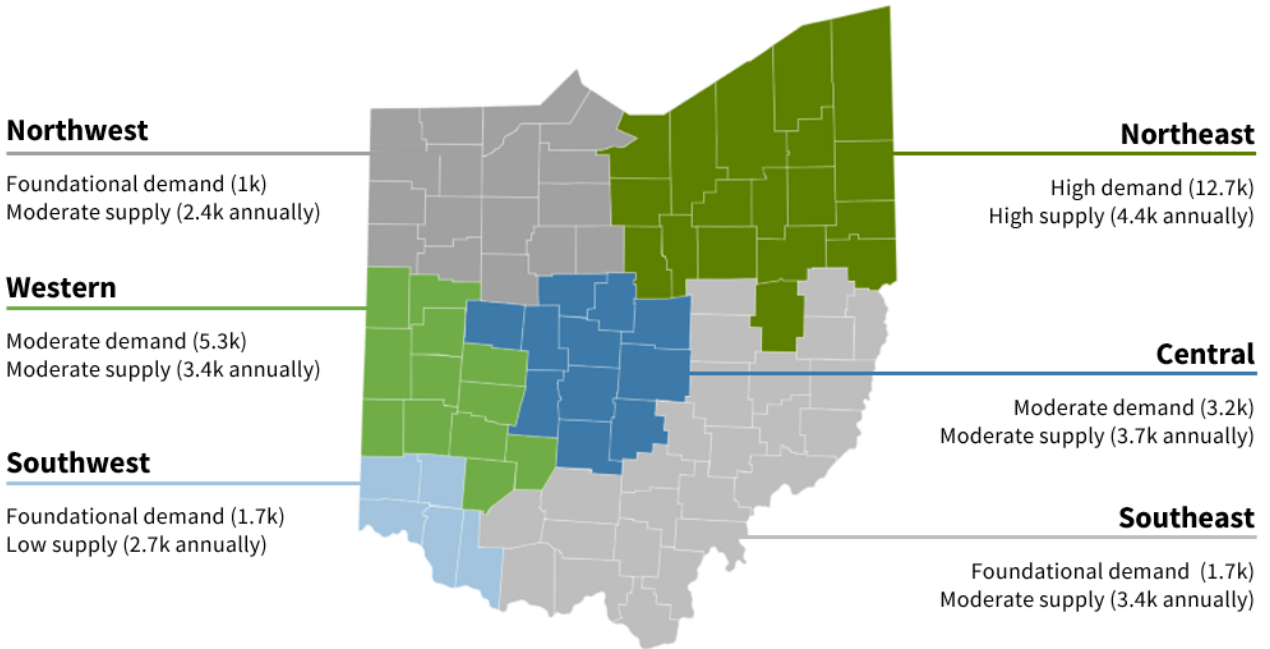
²⁶ The American Immigration Council (2019), “[Immigrants in Ohio](#).”

²⁷ Data on Apprenticeship Programs offered by Ohio Correctional Institutions as of March 13, 2023, provided by the Ohio Department of Rehabilitation and Correction.

²⁸ For more information about what leaders can do to uncover missed talent pools, see Accenture’s 2021 report, “[Hidden Workers, Untapped Talent](#).”

Regional Snapshots: A Catalogue of Ohio Demand and Supply

Each region has unique challenges and opportunities that impact how the statewide strategy is activated at the regional level. This section of the report deep dives into the six regions of Ohio, aligned to the JobsOhio regions defined by county. While each region has unique strengths and features, we recognize that within each region, there are significant nuances and independent needs that will be further developed in the implementation. For more detailed information, including top institutions and key stakeholders, reference Regional Placemats in [Appendix A](#).



Northwest Ohio

Foundational demand (1k)

Demand in this region accounts for only 4% of overall Ohio EV workforce demand. The bulk of new EV-related job growth in Northwest Ohio will be mostly attributable to EV maintenance and EVSE installation and maintenance. As a result, ~1k EV jobs in occupations from electricians to engineers will be needed in the region.

Low supply (2.4k annually)²⁹

Despite low demand, supply in Northwest Ohio is on par with other regions due to four-year education institutions like the University of Toledo and the University of Northwestern Ohio. As a result, Northwest Ohio can be a significant source of talent to EV-related manufacturing in other parts of the state or to advanced manufacturing jobs local to the region.

Opportunity to expand OTC presence and influence

While 4-year institutions are carrying their weight in EV-relevant completions, OTCs have room to grow throughout in the region. Apollo Career Center is the only OTC in Northwest Ohio with EV-relevant program completions – which capped at just 14 graduates in 2021.³⁰

Few regional stakeholders but strong regional education resources, complementary industries

Northwest Ohio has a breadth of education programs tooled from community colleges and employer partnerships, and has significant EV-complementary industries, like solar manufacturing. As Northwest Ohio participates in a state-coordinated workforce strategy, these innovative education programs, like Owens Community College's Advanced Training Center, can serve as best-practice examples. While some workforce and ISPs operate in the region, there exists additional capacity to mobilize, particularly where there is significant industry overlap (e.g., EV and solar).

PROJECTED DEMAND

1k

Total demand through 2030

--% in EV + Battery Manufacturing

25% in EVSE Manufacturing

36% in EV Maintenance

39% in EVSE Install + Maintenance

ANNUAL SUPPLY

353

EV-hirable credential completions in 2021

92

Electrician apprenticeship completions in 2022

14

Ohio Technical Center (OTC) graduates in 2021

485

Community college graduates in 2021

1.5k

4-year private and public colleges graduates in 2021

²⁹ Emsi Burning Glass (now Lightcast) (2023), "[Full School Listing](#)," Lightcast – lightcast.io.

³⁰ Ibid.

Western Ohio

Moderate demand (5.3k)

Western Ohio accounts for 21% of overall Ohio EV workforce demand. Most job growth will occur in the EV + Battery Manufacturing space as large investments ramp up. This is driven by the two largest EV investments in the region – Honda’s \$237M battery retooling plant and SEMCORP’s \$916M new EV facility. With limited demand in maintenance and EVSE installation, the bulk of talent demand will be for manufacturing roles, such as engineers, equipment technicians, and credentialed operators.

Moderate supply (3.4k annually)³¹

While supply numbers are comparable to other regions, there is a significant gap in electrician completions. In 2022, only 35 completions were reported. This highlights a shortage of electricians in the region and the need to expand electrician apprenticeship program awareness. Higher education provides the vast majority of EV supply in Western Ohio. The University of Dayton and Wright State University provide nearly half of the EV-relevant degree graduates. Community colleges - particularly Sinclair Community College - provide about a third of EV-relevant degree graduates. Western Ohio has room to grow in OTC throughput, and training programs should focus their recruitment efforts on expanding workforce diversity.

Employer-led education programs

Sinclair Community College is home to numerous EV training programs. Most notably, it is the only community college in the Midwest to offer the Tesla START Program, which is Tesla’s official career training program for educating professionals on servicing Tesla vehicles. Tesla pays students for their participation and provides the instructor, curriculum, training equipment, vehicles, and tools. Programs like these directly place trainees in the EV job market and ensure retention to the state. Sinclair Community College is also developing programming to address shortages in aftermarket professionals able to repair and maintain EVs. The College also just received a ZEV Education and Awareness grant, funded by Electrify America, that will provide training to 56 incumbent automotive tech workers, Junior Visit Days to expose high schoolers to EV technology, and two public Q&A sessions and EV demonstrations. When developing regional strategies and contributing to the statewide EV collaborative, Western Ohio should consider this program a model for further curriculum development.

PROJECTED DEMAND

5.3k

Total demand through 2030

- 78% in EV + Battery Manufacturing
- 6% in EVSE Manufacturing
- 8% in EV Maintenance
- 9% in EVSE Install + Maintenance

ANNUAL SUPPLY

261

EV-hirable credential completions in 2021

35

Electrician apprenticeship completions in 2022

17

Ohio Technical Center (OTC) graduates in 2021

1.6k

Community college graduates in 2021

1.5k

4-year private and public colleges graduates in 2021

³¹ Ibid.

Southwest Ohio

Foundational demand (1.7k)



Southwest Ohio will account for 7% of overall Ohio EV workforce demand. The bulk of EV-related job growth in Southwest Ohio will be attributable to EV maintenance and EVSE installation and maintenance, with major EV-related manufacturing investments elsewhere in the state. As a result, there will be a strong demand for electrician and electrician technicians over more advanced degrees like engineering.

Low supply (2.7k annually)³²



The University of Cincinnati supplies most of all EV-related graduates across education level and occupation. However, there is room to grow community college and technical center throughput for EV-relevant higher education programs. Looking at electrician apprenticeship and EV-hirable credentials, Southwest Ohio has higher than average completions – a testament to local EV-specific programs that other regions can look to model.

Strong EV-specific education programs can inspire and inform statewide, standardized curricula

Further, as Ohio develops standardized, statewide curricula, programs like Cincinnati State's Electric Drive Mechanisms Course and the University of Cincinnati's EV Racecar Team should be used as best practices. These programs expose students to EVs through hands-on experience. The EV Racecar Team installs EV chargers on campus – so as students learn, they develop the infrastructure for EV adoption to expand on campus, as well.

Growth area for partnerships

While workforce and ISPs operate in the region, there are few EV-related stakeholders currently and there is an opportunity to work across regions to support awareness of EV and advanced manufacturing statewide and local to Southwest Ohio. Southwest Ohio has a historically strong aviation industry, which could also present an opportunity to learn from existing best practices.

PROJECTED DEMAND

1.7k

Total demand through 2030

--% in EV + Battery Manufacturing

27% in EVSE Manufacturing

33% in EV Maintenance

41% in EVSE Install + Maintenance

ANNUAL SUPPLY

252

EV-hirable credential completions in 2021

193

Electrician apprenticeship completions in 2022

37

Ohio Technical Center (OTC) graduates in 2021

189

Community college graduates in 2021

2k

4-year private and public colleges graduates in 2021

³² Ibid.

Northeast Ohio

High demand (12.7k) ●●●

As a manufacturing powerhouse, Northeast Ohio is critical to Ohio's growing EV economy. Half of Ohio's EV job demand is attributed to Northeast Ohio, largely driven by a steady pipeline of \$3.8B of EV investments. These investments -- most notably Ford's EV Assembly Plant expansion (1.8k jobs) and Ultium's new Battery Manufacturing Plant (1.1k jobs) -- drive demand for engineers, equipment technicians, and credentialed operators. While the imperative is automotive electrification, demand for individuals with battery expertise will extend to industries like freight and aviation as they look to electrify, as well. As Northeast Ohio has a growing aerospace industry, demand for manufacturing-qualified individuals will rise.

High supply (4.4k annually) ●●●

As with other regions, there is a surplus of engineers coming out of Northeast Ohio's higher education institutions. The real talent shortage is seen in technical degree graduates and electrician apprenticeship completions. Despite the high regional population, only 156 electrician apprenticeships were completed in 2022. When coupled with the evolving electrification industry in Northeast Ohio, there is a need for increased awareness and earn-and-learn programs to expand the electrician talent pool and meet the demand needs of all regional advanced manufacturing investments.

Robust education resources

Northeast Ohio already has a plethora of programs and academic resources dedicated to developing and upskilling the advanced manufacturing workforce, such as Youngstown State and Mahoning County Career and Technical Center. Tooling U-SME is also headquartered in Cleveland and offers a unique opportunity to provide online content statewide. Unlike other regions, higher education supply is relatively evenly distributed between top colleges and community colleges. OTCs have stronger throughput than other regions, but still account for a minority of graduates. Northeast Ohio should build on its education partners' programs to help industry drive curriculum alignment in the state.

Opportunity for industry collaboration rooted in Cleveland's EV network

Northeast Ohio also has a diverse spread of employers and workforce- and industry-related partnerships, including Foxconn, Battle Motors, MAGNET, and TeamNEO. However, hundreds of training programs and jobs go unfilled in the region resulting in a talent shortage caused by (i) disinterest in the field and (ii) a regional shortage of faculty. Northeast Ohio has the resources and stakeholders to pivot this talent shortage to a talent influx. The largest obstacle will be coordinating these stakeholders to create a seamless pathway into EV careers and close the talent gap. When activating statewide strategies regionally, Northeast Ohio is uniquely positioned to consider leaning into Cleveland's existing resources as a growing tech hub and Mahoning Valley's emerging role as "Voltage Valley". Stakeholders like Ford, Foxconn, and Ultium create a small part of an extensive network of engaged individuals in Northeast Ohio.

PROJECTED DEMAND

12.7k

Total demand through 2030

75% in EV + Battery Manufacturing

6% in EVSE Manufacturing

11% in EV Maintenance

9% in EVSE Install + Maintenance

ANNUAL SUPPLY

730

EV-hirable credential completions in 2021

156

Electrician apprenticeship completions in 2022

62

Ohio Technical Center (OTC) graduates in 2021

1.2k

Community college graduates in 2021

2.3k

4-year private and public colleges graduates in 2021

³³ Ibid.

Central Ohio

Moderate demand (3.2k)

Central Ohio demand accounts for 16% of overall Ohio EV workforce demand. Immediate job growth will occur in the EV and battery manufacturing space as large investments actualize. However, EVSE installation and maintenance quickly takes over as the largest source of job creation, highlighting a need for apprentice-level electricians and electrical technicians. Intel's new microchip factories will also generate demand for a similarly skilled talent pool.

Moderate supply (3.7k annually)³⁴

It is projected that 3.7k EV-qualified individuals are to come out of Central Ohio annually from credentials, apprenticeships, and higher ed programs. Nearly half of the higher education supply in the region is attributed to The Ohio State University. Though OSU's Center for Automotive Research (CAR) is a hub for advanced mobility-related education, it should not overshadow the role smaller institutions have in supplying EV-trained supply at other certificate levels. For example, the National Center for Urban Solutions' NCUS Tec program provides 50+ high-tech, in-demand credentialed programs, many of which are EV-relevant. Columbus State Community College also has an electro-mechanical engineering technology degree that places students in advanced manufacturing roles. While Central Ohio has a multitude of education partners delivering new advanced manufacturing talent, this supply will support all competing advanced manufacturing occupations – particularly Intel's new presence in Central Ohio. Therefore, training programs and awareness efforts should be accelerated to match the expanding demand across advanced manufacturing industries in the region.

Opportunity to tap into untapped talent

Ohio is home to over 528k immigrants³⁵ and the top metro area in Ohio with immigrant population is Columbus (7.5%)³⁶. Columbus has the second-largest Somali community in the U.S., with about 45k Somali immigrants living in the area.³⁷ As Central Ohio looks to alternative talent pools, immigrants will be key to building up the EV workforce, especially because of Ohio's immigrant populations' historic role in the software development and technology fields.

Ample partnership opportunities

Central Ohio also has a strong presence of employers in the EV space that can help drive workforce development across the region. These include Workhorse, ChargePoint, Honda, and LG Energy Solution. This is an opportunity for education programs across the state to further develop earn-and-learn programs and capitalize on these local employers that will quickly need to ramp up their talent intake.

PROJECTED DEMAND

3.2k

Total demand through 2030

13% in EV + Battery Manufacturing

27% in EVSE Manufacturing

18% in EV Maintenance

42% in EVSE Install + Maintenance

ANNUAL SUPPLY

348

EV-hirable credential completions in 2021

152

Electrician apprenticeship completions in 2022

10

Ohio Technical Center (OTC) graduates in 2021

1.1k

Community college graduates in 2021

2.1k

4-year private and public colleges graduates in 2021

³⁴ Ibid.

³⁵ The American Immigration Council (2019), "[Immigrants in Ohio.](#)"

³⁶ National Immigration Forum (2019), "[Immigrants in Ohio.](#)"

³⁷ The Somali Community Association of Ohio (2023), "[About SCAO.](#)"

Southeast Ohio

Foundational demand (1.7k)

Southeast Ohio will account for 3% of overall Ohio EV workforce demand. Most of the demand will be in EV maintenance and EVSE installation and maintenance, generating roles for electricians and EV-trained auto mechanics. Because there are few EV manufacturing opportunities in the pipeline, this region will likely supply talent to major EV and battery investments in other parts of the state or to other manufacturing local to the region.

Moderate supply (3.4k annually)³⁸

To fill this demand, 3.4k EV-qualified individuals – a number comparable to that of other regions – are projected to come out of Southeast Ohio annually from credentials, apprenticeships, and higher ed programs. More than half of the EV-qualified completions in Southeast Ohio are from community colleges.

Opportunity to remove barriers to entry, particularly transportation

Despite these strong programs, hundreds of EV training spots sit empty every year. Southeast Ohio has room to grow in finding solutions to workforce barriers, such as transportation. Breaking down workforce barriers via accessible wraparound services is key to building innovative on-ramps for new talent in the region.

Opportunity to upskill rural populations

There is also a unique opportunity to broaden the talent pipeline by focusing marketing and outreach to rural communities in Southeast Ohio. Ohio has rural areas across regions, but the Appalachian region of Ohio presents a particularly strong opportunity to tap communities that grew up on or near farms and are more adept with hands-on EV trainings and positions.

Growth area for partnerships and employers

The region has fewer workforce and economic development partners than other parts of the state. Fostering these types of partnerships or looking to nearby regions for examples of partnerships and career pathways can be considered to strengthen the region's presence in the electrification industry.

PROJECTED DEMAND

1.7k

Total demand through 2030

--% in EV + Battery Manufacturing

20% in EVSE Manufacturing

49% in EV Maintenance

31% in EVSE Install + Maintenance

ANNUAL SUPPLY

566

EV-hirable credential completions in 2021

36

Electrician apprenticeship completions in 2022

71

Ohio Technical Center (OTC) graduates in 2021

1.8k

Community college graduates in 2021

900

4-year private and public colleges graduates in 2021

³⁸ Emsi Burning Glass (now Lightcast) (2023), "[Full School Listing](#)," Lightcast – lightcast.io.

Balancing Labor Market Dynamics: Supply, Demand, and Critical Occupation Shortages

Current labor market projections seem to indicate there is a surplus of talent supply relative to demand. However, this does not necessarily mean the labor market is in a state of equilibrium. The EV industry is not the only industry vying for these highly skilled workers. The semiconductor industry, which also relies heavily on electrical engineers for example and other specialized technical talent, is also in need of skilled workers to meet their demands. The talent supply is being fiercely competed for across multiple sectors and industries, not just EV, which leads to a situation where certain critical occupations are still experiencing a shortage of qualified candidates.

The below shows EV-related occupation shortages and scarcity as identified during stakeholder interviews and in desktop research. Occupations labeled as ‘critical need’ indicate there is low supply and high demand. Demand for these occupations is driven up by the fact that they are required within multiple industries. Occupations labeled ‘moderate need’ indicate there is a moderate supply and high demand, and those labeled ‘no shortage’ indicates current supply matches demand. The gray lines indicate *where* across the value chain each occupation is needed. Addressing these critical shortages in the labor market will ensure employers have the skilled workers they need, while also providing workers new career opportunities and supporting the growth of local economies.

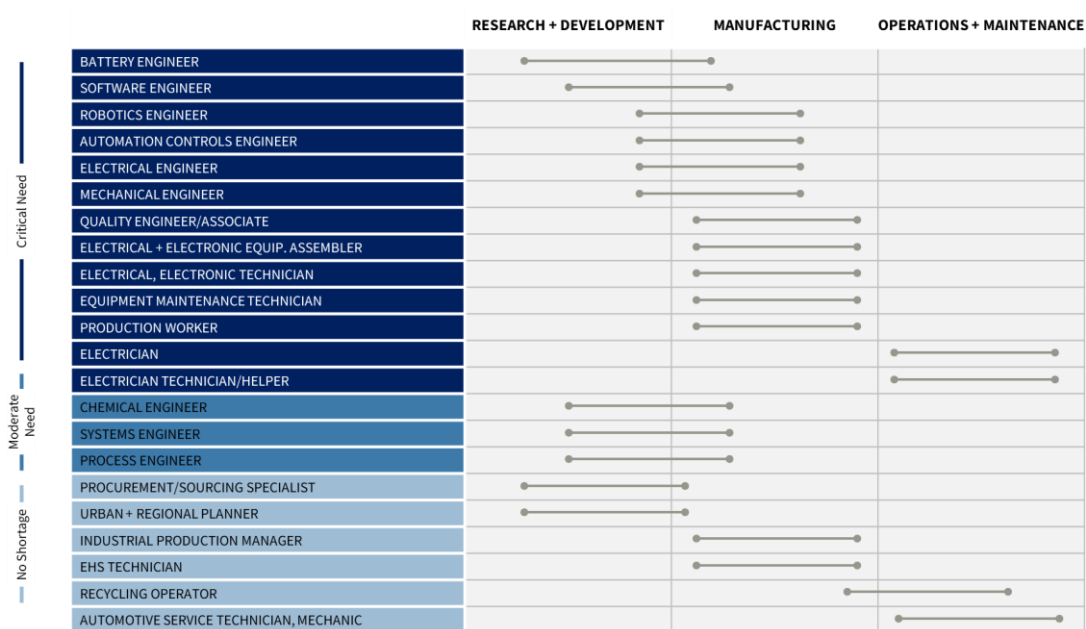
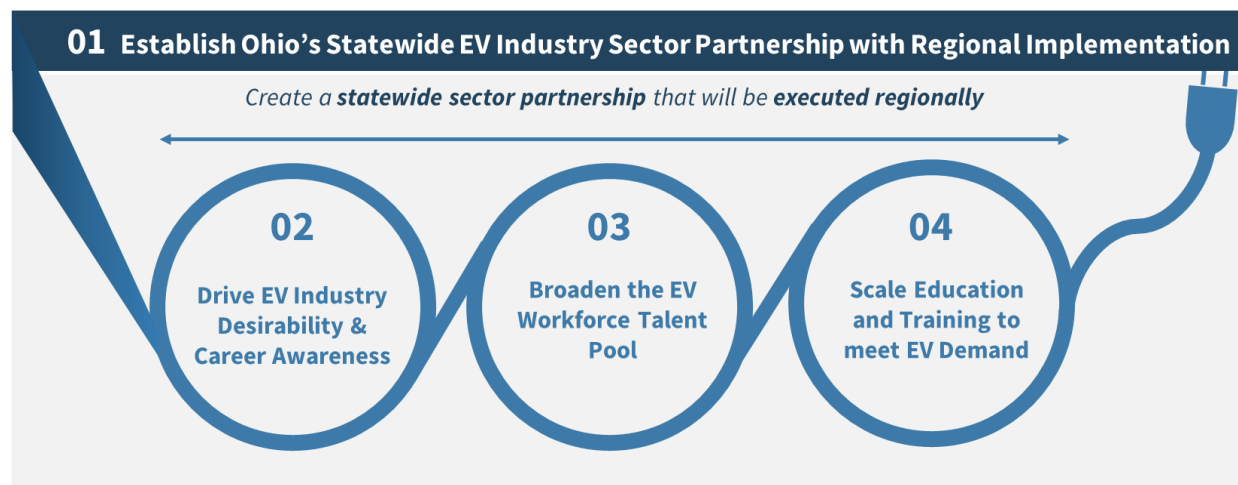


Figure 14: Occupation Shortages across the Value Chain

Ohio's EV Workforce Strategy

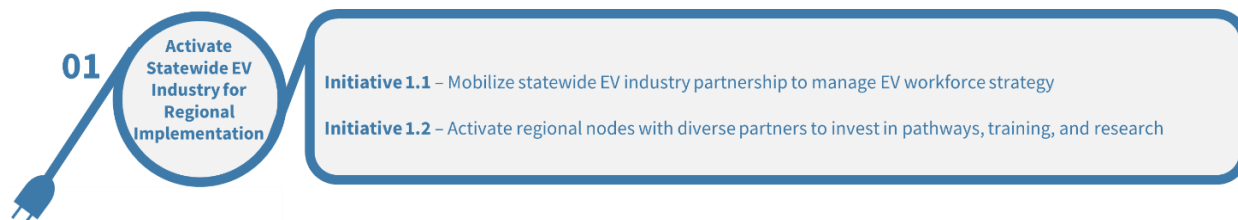
Ohio is pursuing an integrated strategy to bolster its EV workforce. This strategy captures the EV economy's potential and complements other advanced manufacturing growth, such as in semiconductor, aerospace, and solar, across Ohio's diverse economic base. Our strategy is centered on four key pillars to bolster our workforce and enable jobseekers to be on the leading edge of the new EV economy:



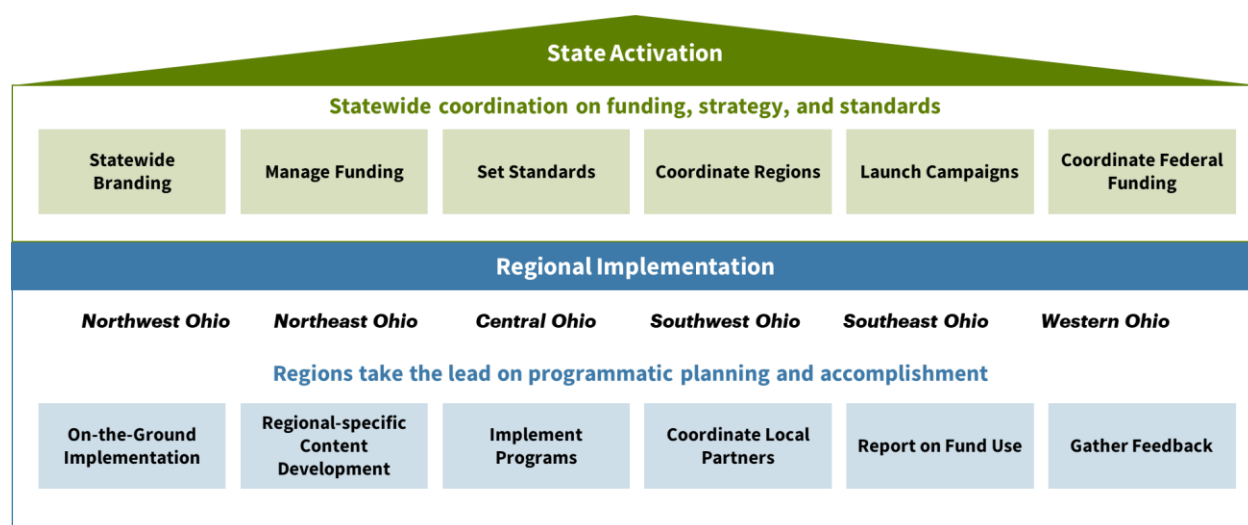
To create this success, we will organize our work in the Coordinating Pillar (01) that will establish Ohio's statewide EV industry sector partnership for regional implementation. Then, across each of our three Action Pillars (02-04) – driving EV industry desirability and career awareness, broadening the EV workforce talent pool, and scaling education and training to meet EV demand – the state will implement key activities (beginning in summer 2023) to deliver outcomes that deliver true growth to our workforce.

Details on each are below, organized by pillar, with each sub-initiative highlighted to demonstrate what success could look like, how to measure success, and with a spotlight on other examples that could be taken to bolster our efforts.

01 Establish Ohio's Statewide EV Industry Sector Partnership for Regional Implementation



Executing a workforce strategy across our diverse state requires a healthy balance of standardization and regionalization. To achieve our objectives, Ohio must create a statewide EV industry sector partnership to coordinate the strategy and initiatives across the state, maximize funding, set standards in conjunction with the rest of the state's workforce system, and minimize duplication. Each region will plug into the statewide partnership to promote alignment and be empowered to work to meet the need of their industry, education, and workforce partners. The figure below outlines the key roles of the statewide team and the regional nodes.



Initiative 1.1 - Establish a statewide EV industry sector partnership to manage the EV workforce strategy

Ohio can accelerate its impact through a multitude of excellent, existing statewide partnerships. These span industries, educational networks, and workforce development. Enhancing and focusing these coordination efforts specifically on the EV industry will accelerate the state's support for the EV workforce.

This initiative depends on identifying and aligning key leaders across the state to shape the EV workforce implementation. This includes identifying organizations willing to devote time and resources to serve on a new quarterly state sector partnership jointly run by the OWT and the OMA. Rationalization of existing activities across state departments will augment this effort, as well as plugging into already established OMA networks, such as the OMA Statewide Alignment Committee and the OMA Leadership Committee. We will bring more EV industry employers to the table, including those who participated in this strategy development process, to truly shape the workforce strategy around their needs.

Sample Initiative Actions Identified:

Statewide Activation Actions

- Establish a statewide EV industry sector partnership that meets quarterly
- Standardize reporting and governance; develop service level agreements for partners, aligning to key success factors to be tracked across each initiative
- Allocate ownership to each initiative to either a state agency or other sector partnership member to ensure responsibility and implementation success
- Manage all funding across the EV workforce roadmap, including braiding state, federal, and private contributions

Regional Implementation Actions

- N/A

Success Factors

- ▲ Increased OMA and ISP membership and participation
- ▲ Increased alignment and partnership across other advanced manufacturing sectors and initiatives
- ▲ Aligned statewide decision making and prioritization
- ▲ Maximized federal and state funding
- ▼ Reduced one-off standards (e.g., bespoke curriculum, competency, or occupation standards)

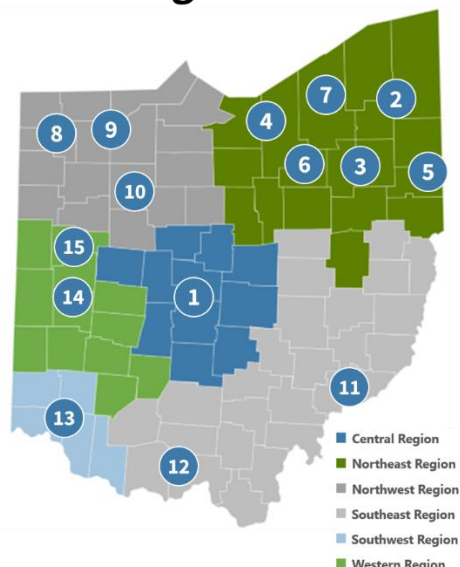
Initiative 1.2 - Activate regional nodes with partners to invest in pathways, training, and research

Ohio's diversity is a strength in developing a strong workforce – with each region holding different industry, educational, and natural resources. To capitalize on this, the EV workforce strategy will be deployed through a regional node infrastructure, based on the OMA's industry sector partnership (ISP) network.

The OMA ISPs will be a strong platform for the customization of the EV workforce strategy execution, enabling each region to hyper-localize and partner with the one or more ISPs within a region and there are 15 endorsed that cover 72 counties across the state. These entities already maintain deep relationships with community partners, educational institutions, and other key players, while formalized governance structures will enable us to move quickly and capture the moment. ISPs should function as a key coordinator within the six regional nodes, mirroring the economic development regions of Ohio, and will be the core coordinator of the industry, academic, and community partners.

If done well, we'll begin to see hubs of activity spread across the state, that build on existing economic clusters and create new ones that support durable industrial growth for generations to come. The ISPs will also harmonize the EV strategy initiatives with already established, and growing, advanced manufacturing industries within the region – building common skills to fuel all industries instead of building in silos.

ISP Alignment to Ohio Regions

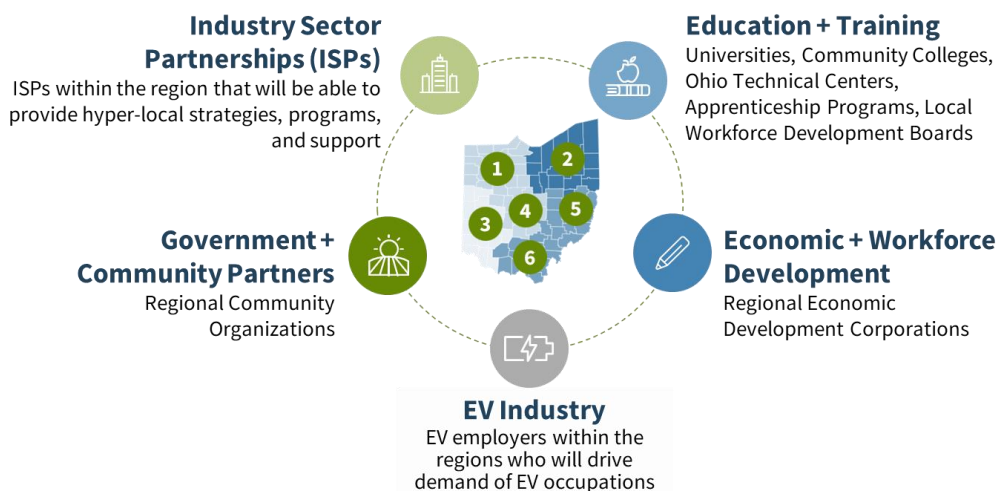


| Map Location | JobsOhio Region | OMA-Endorsed Industry-Sector Partnerships |
|--------------|-----------------|--|
| 1 | Central | Central Ohio Manufacturing Partnership |
| 2 | | Alliance for Working Together Foundation (AWT) |
| 3 | | ConxusNEO |
| 4 | Northeast | Manufacturing Works / Lorain County Manufacturing Sector Partnership (LCMSP) |
| 5 | | Mahoning Valley Manufacturers Coalition |
| 6 | | Stark County Manufacturing WFD Partnership |
| 7 | Northwest | Workforce Connect Manufacturing Sector Partnership |
| 8 | | Advanced Manufacturing Consortium (AMC) |
| 9 | | Toledo Chamber of Commerce / Northwest Ohio Manufacturing Alliance (NOMA) |
| 10 | Southeast | Raise the Bar Hancock County |
| 11 | | Appalachian Ohio Manufacturers' Coalition (AOMC) |
| 12 | | Shawnee State University / BESTOhio Sector Partnership |
| 13 | Southwest | Advanced Manufacturing Industry Partnership (AMIP) |
| 14 | Western | Dayton Region Manufacturing Partnership |
| 15 | | West Central Ohio Manufacturing Partnership |

Going forward, an emphasis will be placed on manufacturer engagement, improved collaboration, and continuous improvement through shared learning within the network. OMA and the endorsed ISPs will work together to increase active participation, lead professional development, and attract funding opportunities, all to expand each ISP's capacity to increase outreach, training enrollment, and job placement.

While ISPs will be a key driver for regional implementation, each role within the node will have a key leading organization to represent the regional workforce ecosystem, referenced below:

EV Workforce Regional Execution Nodes



Sample Initiative Actions Identified:

Statewide Activation Actions

- Create and ratify a governance model with allocated coordinator positions to each region
- Align with Advanced Manufacturing sector commonalities (e.g., semiconductor)
- Assign grant responsibility with designated staffing
- Align federal funding with state funds to maximize impact within each region

Regional Implementation Actions

- Assign leads across partner types (i.e., College, University, ISP, OTC, etc.)
- Surface regional advanced manufacturing commonalities
- Coordinate local partnership network
- Request budget support and report on initiative success



Initiative Spotlight: Earlier in 2022, Youngstown State University and Foxconn announced plans to design and launch a national electric vehicle workforce training and innovation center. The center will focus on scaling workforce education related to advanced manufacturing, energy storage, EV technology, and other integrated technology solutions like artificial intelligence, 5G, and cybersecurity. This center will also use funds from Ultium Cells and General Motors. This partnership is expected to create new job opportunities, support economic growth, and accelerate EV talent pipeline development.



Initiative Spotlight: Funding resources such as Ohio's Environmental Protection Agency charging station grants are building the foundation of Ohio's EV infrastructure. Ohio EPA has awarded \$7.9M in grants to support the install of 150+ publicly accessible DC Fast Charging (DCFC) ports. These grants, and the stations that are installed as a result, will help improve access to public charging for travelers across the state.

Success Factors

- ▲ Healthy balance and mix of regional node partners
- ▲ Increased engagement from regional partners across workforce ecosystem
- ▲ Increased regional relevancy of initiatives
- ▲ Increased buy-in of, and accountability for, initiative execution

02 Drive EV Industry Desirability & Career Awareness



The state has an imperative and an opportunity to excite all Ohioans to deliver on the promise of a 21st century economy. Ohio needs to make the case for its current and future workforce to understand, contribute, and join the industry's workforce. This includes (i) uplifting the brand of the EV industry (ii) shaping the storyline around EV careers as a lucrative, high-growth career pathway, and (iii) providing the tools and support system to learn more.

Initiative 2.1 - Create and amplify new narratives around the EV industry and its career pathways

Ohio should take this moment as an educational opportunity to (i) inform all Ohioans what the adoption and manufacturing of

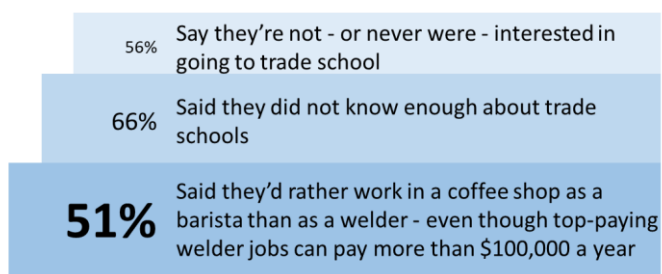
EVs means for them, for the state, and for their children and (ii) showcase the numerous entry points into the space and opportunities for professional growth that come thereafter.

“ My whole career has been built on manufacturing engine-related technology, and I'm proud of that. But the auto industry is going through a once in a 100-year transition, and we are excited to also transition to electric vehicle production.

– Manufacturing Lead, Honda

“What is an EV? What does the future of EVs look like in Ohio? Where can I charge an EV?” These are common questions people ask themselves when considering switching to an EV. Beyond this, there are legacy myths about what it means to work in advanced manufacturing. These myths, coupled with limited exposure, hinder Ohio's capacity to grow the EV industry. Ohio can't grow the EV workforce if Ohioans do not understand what EVs are or the relevance of their projected growth. To move at the pace of the rest of the nation, we need to reinvent the story behind advanced manufacturing and excite Ohioans around the EV transition.

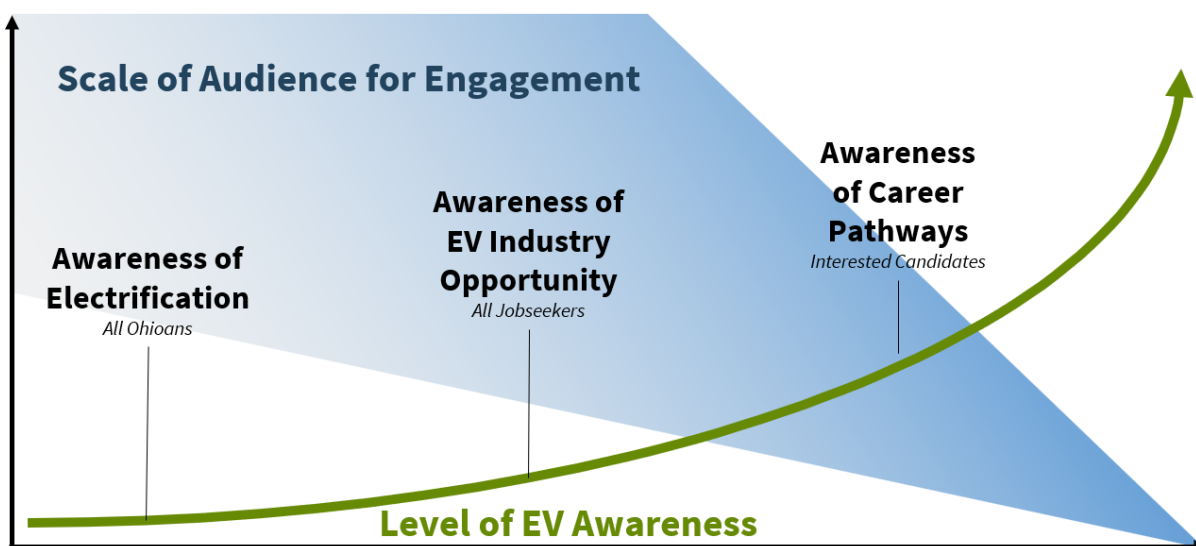
A national survey of men & women 18-24 revealed, on average:



Source: Metal Supermarkets (2019), [“Survey Says: There is a Lack of Awareness and Negative Perception of Trade Schools and Careers.”](#)

A research-based, targeted Ohio-specific marketing campaign can create interest, drive understanding, and foster excitement around all the opportunities provided by EV. This may look like a statewide interactive

website, interactive social media campaigns, or innovative EV awareness competitions to target audiences of all ages. This provides a platform for Ohio to also inspire a new generation of high-tech talent by promoting job flexibility, earning potential, and job advancement options.



Sample Initiative Actions Identified:

Statewide Activation Actions

- Develop campaigns that dispel myths about how Ohio is electrifying transportation to benefit citizens and clarify Ohio's plan, programs, and timelines
- Develop campaigns, or landing page, to highlight the role electrification will play for Ohio and to enhance economic and recruitment efforts
- Design and launch career awareness programs to attract to the EV workforce with regional partners
- Develop EV career pathways models to be shared on Making Ohio website

Regional Implementation Actions

- Host and implement innovative awareness programs to inspire job seekers and inform them of career pathways
- Partner with community organizations to host EV awareness events (e.g., webinars, conference speaking slots, pre-recorded video pitches)



Initiative Spotlight: Electric school bus investments are on the rise with districts across Ohio making investments in low-pollution vehicles for our children. From Madison Plains to Toledo, these new buses are going to showcase the advanced technology of EVs to young students and build excitement around the potential of electrification. The US Environmental Protection Agency (EPA) solicited rebate applications for \$500 million through the 2022 Clean School Bus Rebates for zero-emission and low-emission school bus rebates. EPA's Clean School Bus Program provides \$5 billion over the next five years (FY 2022-2026) to replace existing school buses with zero-emission and low-emission models.



Success Factors

- ▲ Increased awareness of EV Industry
- ▲ Increased awareness of, and interest in, EV-related career pathways and available training programs
- ▲ Improved public perception of advanced manufacturing careers

Initiative 2.2 - Reimagine K-12 engagement to cultivate long-term EV talent pipelines

The EV workforce of tomorrow starts with exciting the youth of today. Ohio needs to reimagine outreach to engage K-12 students to build broad EV awareness, position EV as an enticing, sustainable career opportunity, and fuel EV growth across Ohio.

Early exposure to STEM careers, coupled with awareness campaigns [Initiative 2.1], will dispel current ill-informed perceptions of advanced manufacturing and build a pipeline of enthusiastic and capable high school graduates. Without this pipeline, Ohio cannot realize the full potential of an expanded advanced manufacturing economy.

Each regional network will be charged with bringing new K-12 engagement ideas and pilot programs to fuel interest in the EV industry and promote EV career pathways through real, hands-on experiences. A few ways this may take shape include EV driver education programs, field trips, district-wide competition programs, ambassador programs, and stronger links between the EV workforce and existing data analysis and technology curricula. Another quick win is to make students aware of the plethora of EV-hirable industry-recognized credentials that can provide them with the base-level skills and competencies to get started on an EV career pathway at no cost to the student. At the state level, building out incentives or rewards in the form of scholarships to Ohio educational EV programs can also be explored.



Building a pipeline of enthusiastic and capable high school graduates with exposure to STEM careers helps the state position for generations of economic growth and keeps Ohio competitive in attracting business investments. Further, current ill-informed perceptions of manufacturing and automotive work paint a nonattractive picture that discourages young graduates and their support networks from considering these paths. At the same time, computer and technology classes are often presented as a pathway to a 4-year degree and a desk job. Demonstrating the link between data analysis, technology, and electrification could entice a new segment of students to the EV industry.

This initiative will be carried out by directly engaging with K-12 institutions to provide real, hands-on experiences to grow student interest in this space. Incorporating EVs into driver education programs, coordinating field trips, and facilitating ambassador programs, guest speakers, incentive programs, or district-wide competitions are all possible means of increasing student exposure early.

Sample Initiative Actions Identified:

Statewide Activation Actions

- Develop and distribute K-12 EV career pathway guides
- Highlight industry engagement best practices

Regional Implementation Actions

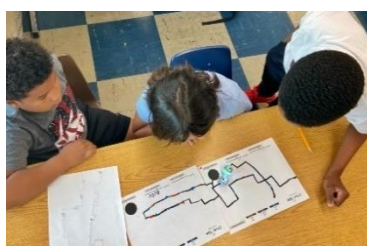
- Assign leads across school districts and key regional collaboratives
- Scale existing programs such as [DriveOhio's Smart Mobility Ambassador](#) and Career Connections
- Build campaigns that offer young students' direct exposure to the EV industry
- Identify and establish partners for work-based learning opportunities for high school students



Initiative Spotlight: NASA Glenn Research Center's [FIRST Robotics Competition Buckeye Regional](#) inspires high school students to apply STEM, leadership, and emotional intelligence skills through involvement in a team-based robotics competition. Scholarships are provided to participating Ohio teams attending the Buckeye Regional.



Initiative Spotlight: [INFOhio](#) is Ohio's PreK-12 digital library, providing high-quality, digital learning content for Ohio's PreK-12 schools. INFOhio built web tools like GO! Ask, Act, Achieve and Research 4 Success that help teachers guide students in the use of the content. INFOhio also provides support for the library services platform used in most Ohio schools and provides training, support, and professional development for the educators. Incorporating EV educational material within INFOhio would expand outreach to the K-12 community.



Initiative Spotlight: [DriveOhio's Smart Mobility Ambassador](#) Program aims to engage students of all ages in conversations about next-generation emerging career opportunities in Ohio. K-12 students learn about self-driving cars, flying drones, and electric vehicles by exploring robotics, logistics, aviation, artificial intelligence, coding, game design, cybersecurity, and semiconductors.



Success Factors

- ▲ Increased number of completed EV-relevant, EV-hirable, and advanced manufacturing high school credentials
- ▲ Increased number of schools with an EV-related course or credential offering
- ▲ Increased number of schools with EV-related engagement opportunities (e.g., site trips, guest speakers)
- ▲ Increased EV employer participation in K-12 system

Initiative 2.3 – Equip local career counselors, career centers and families to support EV careers

K-12 engagement goes beyond student outreach and needs to include those most influential to the next generation’s future: parents, teachers, and career counselors. Without encouragement from students’ support systems, the potential of K-12 student engagement [Initiative 2.2] will go unrealized. Typically, these role models lack awareness of EV career prospects and can deter students from pursuing advanced manufacturing careers. Beyond a foundational knowledge of EVs [Initiative 2.1], parents, teachers, career counselors, and local career centers must be equipped with the tools to advocate and guide students and jobseekers through EV career pathways.

ISPs, OEMs, and education partners must inform and support role models and local career centers by creating and sharing resources about EV pathways. These resources can help usher talented individuals into EV occupations. Some key initiatives that may be considered include educational sessions, role models, industry facility site visits, and open house events. These can all foster career opportunity awareness at the role model level and provide the foundational support system needed for students to pursue advanced manufacturing.

Sample Initiative Actions Identified:

Statewide Activation Actions

- Create and deploy support materials and collateral for individuals to trumpet the opportunities in the EV workforce
- Develop campaigns that highlight the role that the advanced manufacturing economy will play in Ohio

Regional Implementation Actions

- Integrate materials and models into current and future programs



Initiative Spotlight: The Educational Service Center of Eastern Ohio’s [Building Trades Pre-Apprenticeship Program](#) hosts industry partners who provide mentorship to students and bring in professionals to share trade career experiences, expertise, and enthusiasm. This program networks tightly with the career counselors at ESC to work alongside industry and create awareness among students of the Building Trades.



Initiative Spotlight: OWT’s [Career Pathways Resource](#) highlights different career pathways, like College Credit Plus and Pre-Apprenticeships, available and features testimonials from students sharing their experiences with each pathway. An accompanying toolkit encourages Ohio students, parents, and schools to start conversations about pathway options to a successful career in Ohio.

Success Factors

- ▲ Increased exposure to, and promotion of, post-secondary EV training opportunities and career pathways
- ▲ Increased career counselor awareness of EV careers
- ▲ Increased participation from families in EV career awareness programs

Initiative 2.4 - Retain post-secondary graduates from Ohio institutions

It is not enough to only funnel students into the EV workforce pipeline. Ohio needs to also retain that talent in state post-graduation to build up the local economy. Ohio offers top-tier education and cultivates some of the best talent across the country. However, if Ohio can't retain these skilled graduates, the state is effectively subsidizing other states' skilled labor forces.

Higher education completers are one of the most expensive within the state. When these graduates migrate, the direct benefit accrues to receiving states and the homegrown state bears the cost of the lost opportunity. As Ohio's higher education system invests in the next generation of workers, it must also promote Ohio as a place for graduates to stay and grow. This is particularly salient for the electrification industry where those with bright potential can have an outsized impact across our new and expanded employers.

Emigration is a significant workforce challenge in Ohio as, across post-secondary institutions, roughly 26% of graduates leave the state in pursuit of employment elsewhere. Models developed based on publicly reported emigration statistics estimate the emigration of higher education graduates from EV-relevant programs at Ohio institutions to be over 6.5k annually.³⁹

To retain Ohio graduates, Ohio needs to ensure that students view the state as a place to grow and catalyze their careers. Ohio stakeholders should consider offering incentives such as student loan forgiveness, postgraduate tuition assistance, and tax credits for those who enter the EV industry field.



Initiative Spotlight: The Ohio Department of Development offers programs such as [The Diversity & Inclusion Technology Internship](#) that links students to technology programs. Companies that hire interns receive reimbursement for two-thirds of the intern's wage (up to \$7,500). Employers should be made aware and leverage this program to create more internships and give students the knowledge and experience needed to catalyze their careers in the EV Industry.

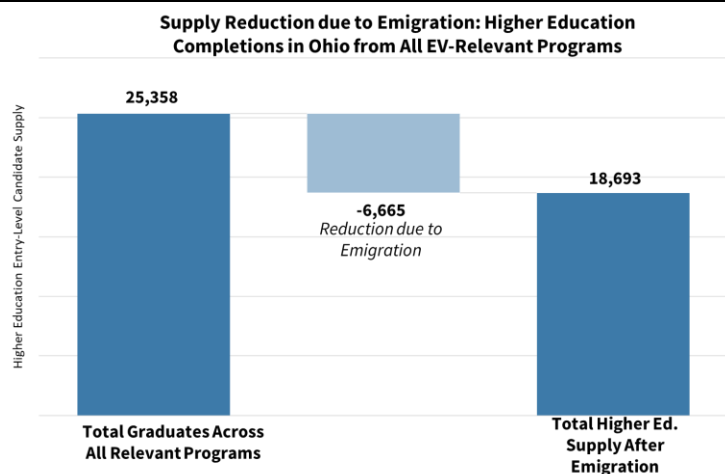


Figure 15: Ohio's Estimated Higher Education Supply Reduction

³⁹ Reduction due to emigration from Ohio was calculated using 2011-2020 PSEO data and Lightcast Profile Analytics Data (2023) to determine the number of graduates leaving Ohio. Emsi Burning Glass (now Lightcast) (2023), "Profile Analytics" Lightcast – lightcast.io. U.S. Census Bureau (2023), "[Post-Secondary Employment Outcomes](#)."

Sample Initiative Actions Identified:

Statewide Activation Actions

- Develop and provide financial incentives for students to join the EV workforce in Ohio
- Develop and provide financial incentives for in-state recruiting of college and university graduates (e.g., subsidized apprenticeship/co-op programs, talent attraction)

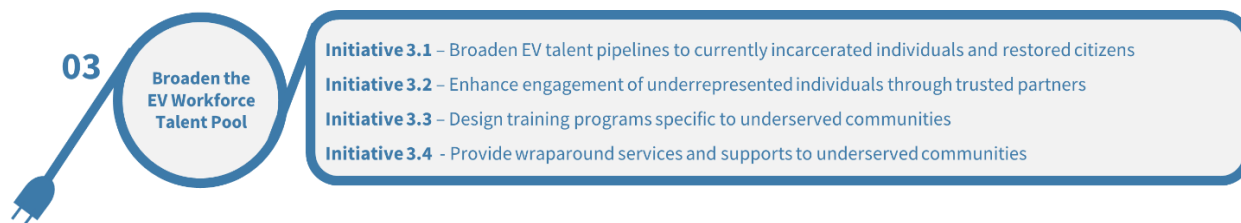
Regional Implementation Actions

- Deploy, administer, and subsidize financial incentives for students to join the EV workforce in Ohio

Success Factors

- ▲ Increased retention percentage (i.e., percentage of those who obtain an EV, EVSE, or battery-related degree and reside in Ohio post-degree obtainment)
- ▲ Increased placement of Ohio graduates into EV occupations

03 Broaden the EV Workforce Talent Pool



Deepening and broadening the EV talent pool requires enabling the supports and partners that will bring underserved communities into this supercharged industry. By strengthening partnerships with local organizations, we can open new talent tools and increase access to critical supports like transportation and childcare.

This hinges on filtering in talent pools that currently don't contribute significantly to the automotive workforce like currently incarcerated individuals and restored citizens, immigrant populations, and underrepresented communities and ensures that the thousands of people who are eager to and possess - or could develop - the skills employers seek, are a part of this high-growth industry.

Initiative 3.1 - Broaden EV talent pipelines to currently incarcerated individuals and restored citizens

Historically, those who are currently or previously incarcerated are often overlooked as a labor pool that brings experience and enthusiasm to work opportunities. As the economy surges and OEMs and Tier 1's struggle to find enough workers to fill job roles, extending the talent pipeline to restored citizens will significantly help employers outlast labor shortages and address recidivism reduction goals for the state. The Ohio Department of Rehabilitation & Correction (ODRC) has a broad network that provides services and programming for restored citizens, with a goal of reducing recidivism across the state. Coordinating with ODRC will be vital as this organization will be able to share roles and subsequent skills that restored citizens could fill. While many industries have limitations on the ability for restored citizens to serve (including over 600 occupations in Ohio alone), these individuals can be well-equipped to take roles in the EV industry, such as welders, quality control specialists, and auto mechanics.

Sample Initiative Actions Identified:

Statewide Activation Actions

- Develop and deploy an employer-focused campaign on the value of recruiting restored citizens
- Partner with OEMs and the Ohio Department of Rehabilitation and Corrections to develop a career pathway for restored citizens

Regional Implementation Actions

- N/A



Initiative Spotlight: Programs within the Ohio Department of Rehabilitation & Correction, such as the [Offender Workforce Development](#), help restored citizens enhance employability through training, education, technical assistance, and job search. Currently, 118 of 413 programs offered throughout Ohio Correctional Institutions are EV-relevant or EV-hirable, including an electrical maintenance program that is offered in 15 institutions statewide. Leveraging the Offender

Workforce Development program will be vital as we seek to connect restored citizens to the EV industry.

Success Factors

- ▲ Increased number of individuals who complete an EV-relevant or EV-hirable program while incarcerated or after release
- ▲ Increased percentage of overall workforce who is an incarcerated or restored citizen
- ▲ Increased number of EV-related or EV hirable programs for currently incarcerated individuals

Initiative 3.2 - Enhance engagement of underrepresented individuals through trusted partners

Increasing representation from women and people of color in the EV industry will be crucial for the growth and development of the EV workforce. Diversity in manufacturing is essential for businesses to succeed and remain competitive, not just achieve corporate objectives. Developing and maintaining partnerships with trusted community partners will allow employers to tap into a broader network of communities they may normally not be able to reach.

These partners have the trust and social capital to bring together key workforce and education partners with the goal of providing comprehensive services to individuals searching for jobs and to employers looking for skilled workers to fill their job openings. This could include community partners hosting on-site hiring events, webinars, and speaking engagements to attract new talent within the community. Employers meeting residents where they are within the community provides significant opportunities for underrepresented individuals to access job roles within the industry.

Sample Initiative Actions Identified:

Statewide Activation Actions

- Equip community organizations to engage their network to provide opportunities to targeted communities
- Design and launch underrepresented recruiting programs

Regional Implementation Actions

- N/A



Initiative Spotlight: Community organizations like The National Center for Urban Solutions (NCUS) engage community members, employers, and influencers to develop economic and workforce development programs with the goal of unlocking untapped talent. Their models of community engagement provide a unique opportunity to connect underserved communities with job opportunities within the EV industry. Additionally, [NCUS's Information Technology Accelerator Partnership Ohio](#) (ITAP Ohio) provides workforce training and career opportunities to underserved communities throughout Ohio. This partnership has provided African Americans equitable access to Ohio's IT sector by increasing training, recruitment, and connecting individuals to high paying jobs.



Initiative Spotlight: [WorkAdvance](#) is an ISP-led, Good Jobs Challenge supported learning program that creates a talent pipeline for entry-level manufacturing positions from Ohio's untapped workforce of underrepresented populations and untapped workers. The program combines recruiting, career technical training, pre-screening, onboarding and ongoing support and one-on-one job coaching to allow for individuals to begin a lifelong career in advanced manufacturing. WorkAdvance also supports the upskilling of advanced manufacturing employees to grow their knowledge and skills that will strengthen the local advanced manufacturing workforce. All program graduates receive an industry-recognized credential and guaranteed interviews with local manufacturers.



Success Factors

- ▲ Increased number of trusted partner organizations
- ▲ Increased number of individuals reached through trusted partners
- ▲ Increased underrepresented community participation and enrollment in programs

Initiative 3.3 - Design training programs specific to underserved communities

Diversity can open access to new talent, enabling companies to attract and retain top-tier employees. Developing more flexible training options to accommodate women and minorities creates a positive environment that will appeal to individuals from these targeted demographics.

Offering mentorship and training opportunities to underserved communities in the manufacturing industry can help individuals develop the skills they need to be successful in this field. By providing these opportunities, OEMs and Tier 1's can help increase the number of underserved individuals within the manufacturing sector and contribute to a stable economy.

By providing resources, training, and support, OEMs and Tier 1's can help make the transition into manufacturing a more rewarding experience for women and minorities. This can be done by designing an apprenticeship program with educational and support programming through a cohort approach.

Sample Initiative Actions Identified:

Statewide Activation Actions

- N/A

Regional Implementation Actions

- Define underserved community (e.g., by location, ethnography)
- Create one or more formal earn-and-learn cohort style programs
- Run and launch accessible and comprehensive training activities (i.e., incorporating English as a Foreign Language, hosting programs in libraries and job sites)



Initiative Spotlight: Programs like the Governor’s Office of Workforce Transformation’s [High School Tech Internship Pilot Program](#) motivate and enable students to pursue internship opportunities that showcase Ohio’s diverse industries. At the collegiate level, the University of Cincinnati College of Engineering and Applied Science’s [co-op requirement](#) is one example of a successful effort to provide tangible work experience and embed students further into local communities to retain them in state after graduation.

Success Factors

- ▲ Increased perception of Ohio’s advanced manufacturing inclusiveness
- ▲ Increased representation of underserved communities in EV workforce

Initiative 3.4 - Provide wraparound services and supports to underserved communities

Providing wraparound support services aids in setting the conditions to expand the workforce with more women and low-income neighbors participating. More specifically, creating a support network for underserved individuals in the EV industry will allow disadvantaged communities to access programs seamlessly.

A lack of access to affordable childcare and transportation assistance is an ongoing contributor to workforce challenges and labor shortages. With proper aid for wraparound services like childcare and transportation, candidates can take on new job roles. This support is vital for future recruits who face several disadvantages when trying to pivot their careers.

State agencies can provide funding and expand existing programs that provide access to childcare and incentivize industry partners to offer wraparound services to potential candidates.

Sample Initiative Actions Identified:

Statewide Activation Actions

- Maximize eligibility and funding for wraparound services (provision of transportation, childcare, bringing digital divides through cellular and Wi-Fi provision) to EV workforce

Regional Implementation Actions

- Incentivize industry to provide tailored wrap around services for underserved communities (i.e., offering on-site childcare, tuition assistance, career coaching)



Initiative Spotlight: [The United Way of Greater Cleveland](#), in collaboration with other community partners such as Towards Employment, Jobs Ohio, Team NEO, etc., are working together to further understand and address social factors that prevent individuals from entering the workforce. Through this collaboration, eight “social determinants of work” (childcare, sustained education, transportation, etc.) have been identified. This critical partnership is a tool and information hub needed to scale wraparound services for workers.

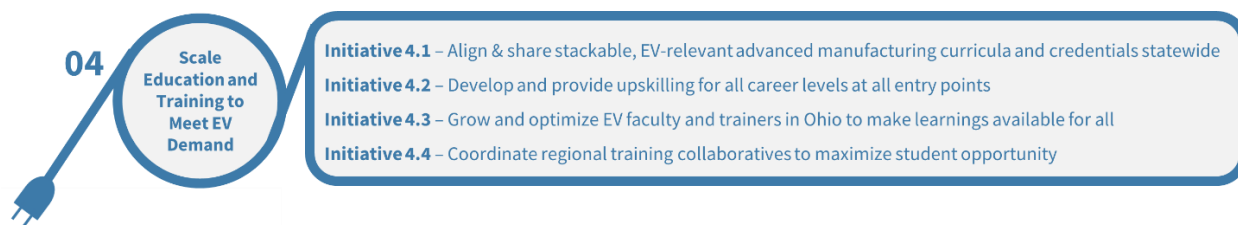


Initiative Spotlight: Additionally, the [OWT’s Individual Microcredential Assistance Program](#) provides support to low-income, underemployed, or unemployed Ohioans for tuition, fees, and other costs associated with earning a credential that can lead to a good job.

Success Factors

- ▲ Improved service utilization rate (# of individuals using services / total population served)
- ▼ Reduced service delivery time rate (time between service delivery and initial service request)
- ▲ Improved satisfaction of services
- ▲ Positive education and employment outcomes for those receiving services
- ▲ Increased state competitiveness in securing EV private investments due to community-provided wraparound services

04 Scale Education and Training to Meet EV Demand



To fill the currently estimated 25k EV jobs coming to Ohio by 2030, we need to continue scaling advanced manufacturing education to transition existing talent and access new, traditionally underserved talent pools like women, immigrants, people of color, and rural communities. There are already a plethora of programs and initiatives dedicated to growing advanced manufacturing talent in Ohio, but there is room for alignment and growth so that EV can act as a force multiplier for related industries like semiconductor, aerospace, and solar.

Initiative 4.1 - Align and share stackable, EV-relevant advanced manufacturing curricula and credentials statewide

As with any nascent industry, there are not yet standardized curricula and credentials that enable our workforce to understand career progression, transition between employers, or build the logical competencies. The state has great potential to enable an industry-led curriculum development that builds on industry-recognized customizable credentials and stacks across higher education levels, creating the highly skilled workforce of tomorrow. To achieve this, the Ohio education and training ecosystem should invest in curriculum projects that support the common market needs.

Many roles in advanced manufacturing share competency requirements across industries. This means that those pursuing fundamental skills are preparing themselves for career paths in multiple advanced manufacturing industries. EV must grow alongside these industries, but with a currently unaligned portfolio of credentials, certificates, and degrees, the industry risks falling behind and failing the workforce.

The statewide EV industry sector partnership will coordinate syllabi and curriculum cooperation among education providers, OEMs, and suppliers to review and validate through coordinated curriculum assessment sessions. Existing advanced manufacturing programs should then be supplemented with EV-specific content developed by education partners and OEMs. Opportunity exists for scaffolding curriculum with stackable credentials across Ohio.

Sample Initiative Actions Identified:

Statewide Activation Actions

- Establish a statewide curriculum committee
- Coordinate curriculum development efforts with other statewide curriculum development initiatives related to EV, such as semiconductors, to drive similarity amongst advanced manufacturing
- Create standardized job-to-training career and education pathway maps
- Create sample industry-recognized credential “bundles” relevant to specific advanced manufacturing industries (EV, semiconductor, aerospace, solar, etc.)
- Develop new skilling programs with organizations like ODOT’s DriveOhio specific to EV (e.g., battery engineers, EV infrastructure technicians) to address immediate needs, while staying abreast of the creation of newly emerging industry-recognized credentials (like SAE + ChargerHelp!’s EVSE technician certification)

Regional Implementation Actions

- Validate curriculum with local industry partners and their high demand occupations
- Use existing systems (OhioLink) for curriculum-sharing efforts



Initiative Spotlight: To date, there is no industry-recognized non-electrician credential in EVSE operations and maintenance. The industry emerging certification from the Electric Vehicle Infrastructure Training Program (EVITP) requires learners to be electricians – putting the credential out of reach for many. To help address this need, ChargerHelp! and the Society of Automotive Engineers are developing an industry-recognized non-electrician EVSE credential⁴⁰. This partnership and curriculum should strengthen the case that there are discrete, technical, software-oriented, and industry-recognized essentials that can be codified nationally.



Initiative Spotlight: Columbus State Community College is leading the development of an [Ohio-wide college collaborative](#) creating two-year degree pathways for semiconductor chip manufacturing technicians. This initiative’s efforts will create an open, shareable, credentialed curriculum amongst all of Ohio’s community colleges. Given the large overlap in competencies between semiconductor and EV, this statewide collaborative approach can serve as a blueprint for analogous EV initiatives.

Success Factors

- ▲ Increased number of EV industry-recognized credentials sought by multiple employers
- ▲ Increased EV course content shared between learning institutions
- ▲ Increased incorporation of EV-relevant or EV-hirable credentials into existing curricula

⁴⁰ SAE (2022), “[SAE International and ChargerHelp! Announce Partnership to Assist in EV Charging Infrastructure Workforce Development.](#)”

Initiative 4.2 – Develop and provide upskilling for all career levels at all entry points

Ohio's workforce is a structural advantage for the state with strong advanced manufacturing and legacy automotive strengths. Many roles share similar foundational competencies; for instance, the electrification and semiconductor industries not only share approximately 80% foundational advanced manufacturing competencies but have overlapping industry-specific technical competencies. This overlap can be an advantage to Ohio spanning existing ICE workers to new entrants.

The existing workforce needs new upskilling to prepare for EV manufacturing jobs. Identifying the workers most at risk from structural unemployment to deliver training is critical but not enough. A holistic mapping of the new skills required, then organized into rationale training programs, is the only way to effectively build a new advanced manufacturing workforce. Example programs such as Michigan's Energy Transition Impact Project (ETIP) help identify and develop reskilling. New entrants also need to be able to clearly access the right sequential training based on their interests and career objectives. Individuals can enter occupations through formal education, on-the-job training, experience, credentials, or apprenticeships.

Regardless of entry point, extensive on-the-job training for workers is vital for the career trajectory of EV workers. For example, electricians' career advancement progresses from apprentice to journeyman and master electrician, via on-the-job experience. This growth can occur by moving through an electrical apprenticeship or by additional on-the-job trainings to mid-level roles with similar competencies. Additionally, investment in upskilling and reskilling increases employee attraction and retention. In a recent Gallup survey, 61% of respondents said that the opportunity to participate in an upskilling program was "very" or "extremely" important for them in determining whether they would stay at their job.⁴¹

Sample Initiative Actions Identified:

Statewide Activation Actions

- Develop the roadmap and ICE Reskilling program for incumbent workers
- Develop on-the-job programing and apprenticeship guidance

Regional Implementation Actions

- Provide tailored counseling and opportunity search and training mapping unique to individual jobseeker needs
- Design subsidization and facilitation model for upskilling programs
- Pilot programs with key OEMs to bring on-the-job training efforts to their workforce and refine programs



Initiative Spotlight: Initiatives like [Ohio's TechCred program](#) sets the conditions to build a strong and stable workforce by providing Ohioans with the tools and resources needed to learn new skills in technology. The program overall takes individuals a year or less to complete. Modeling the program to allow incumbent workers to gain skills in the EV industry will imprint a tremendous impact on their careers.



Initiative Spotlight: Clark State College operates several facilities around Ohio, offering flexible programs for neighbors to acquire and re-up their Commercial Drivers License. In their existing programs, they have included an electrification component to highlight new industries and entry points.

⁴¹ Gallup (2021), "[The American Upskilling Study: Empowering Workers for the Jobs of Tomorrow.](#)"



Initiative Spotlight: [AAA Technician Training program](#), in partnership with DriveOhio (included on the TechCred Credential List), currently provides a hybrid vehicle repair training course, with more in development. Programs such as these will be required to keep ICE vehicle maintenance technicians up to speed with the required skills to service an electric vehicle.

Success Factors

- ▲ Increased number of employees participating in upskilling programs
- ▲ Increased number of employers offering EV-related upskilling programs
- ▲ Improved employee retention as a result of upskilling program development
- ▲ Improved talent attraction as a result of upskilling program creation

Initiative 4.3 - Grow and optimize EV faculty and trainers in Ohio to make learnings available for all

We need to create diverse, competitive, and engaged educators to meet the growing demand for skilled EV talent. These educators need practical and relatable experience and an aptitude for teaching to excite learners at all levels and share experience beyond theory. Ohio's current instructor shortage is particularly acute because of the nascence of the EV industry, leaving few who have significant experience willing to leave the front lines to teach and challenging those who do with diverse and conflicting curricula, as Initiative 4.1 seeks to address.

To find enough skilled and qualified instructors, Ohio will pursue activities that bolster the pipeline of educators through providing opportunities to learn to teach, identify career pathway expansion, break down barriers to entry, and provide a more competitive value proposition for the best to teach the rest.

Sample Initiative Actions Identified:

Statewide Activation Actions

- Adjust instructor eligibility criteria to reflect maturity of industry (i.e., adjusting industry experience requirements where not fundamental to outcomes)

Regional Implementation Actions

- Identify and deploy creative incentives for faculty recruitment and retention (e.g., increase pay, formalized pathways, promotion timelines)



Initiative Spotlight: Lorain County Community College partnered with Rockwell Automation, IST Ohio and FANUC America to develop [Industry 4.0](#)

[Teacher Training](#). This program prepares teachers to deliver I4.0 technology training in classrooms of all levels (high school through university) via in-person and online learning. The program includes an externship to ensure teachers have on-the-ground, field experience prior to launching their teaching careers.



Success Factors

- ▲ Increased program capacity
- ▲ Increased program participation
- ▲ Increased number of EV-qualified faculty

Initiative 4.4 - Coordinate regional training collaboratives to maximize faculty & resources

To move at the pace industries demand, Ohio needs to coordinate training and education using the regional model that was the focus of Initiative 1.2. This will be essential to matching EV workforce demand with the dedicated training collaboratives that can match regional student demand to employer need, share educational resources, and maximize our faculty.

EV training is currently restricted by costly equipment. To mitigate this, education partners should collaborate statewide to create collective purchasing agreements, optimize resources, and avoid unnecessary expenses. Industry-experienced faculty can also be shared across regions to ensure high-quality faculty are providing training statewide. Coupled together, faculty- and equipment-sharing have the potential to accelerate EV training and supply across the state.

Some potential strategies may include:

- Sharing equipment and simulators between training and education partners to enable student learning across facilities and technology
- Working across key regional institutions to submit budget requests and provide students transportation to learn at other sites
- Planning faculty rotations between institutions to maximize the impact of industry professionals who are eager to share their expertise

Sample Initiative Actions Identified:

| Statewide Activation Actions |
|--|
| <ul style="list-style-type: none">• Establish regional education councils with faculty-sharing models |
| Regional Implementation Actions |
| <ul style="list-style-type: none">• Use programs that can optimize investments in equipment and facilities |



Initiative Spotlight: Governor DeWine’s as introduced FY 2024-25 budget prioritized hundreds of millions of dollars to support purchasing equipment for career technical centers and postsecondary institutions so students are trained on the modern equipment they will encounter in the workplace. In addition to equipment support, this funding would also be used to support facility expansion and renovation to ensure Ohio has the program capacity to meet industry needs. The funding would be prioritized for programs that support Ohio’s Top Jobs List and Innovative Workforce Incentive Program (IWIP) credentialing programs in sectors that most urgently need employees. To complement this provision, the OMA is requesting \$10 million over the biennium to create competitive manufacturing grants enabling manufacturers to invest in equipment to help modernize and innovate production processes.

| Success Factors |
|--|
| <ul style="list-style-type: none">▲ Increased monetary amount of equipment being shared across institutions▲ Increased number of instructors shared across institutions▲ Increased number of students using shared equipment |

Funding & Governance for the EV Strategy

Maximizing Funds Through Braided Funding

Strategy without action leaves leadership frustrated, workers disenfranchised, and the state behind. That is why we've built an early coalition to ensure the political and industrial will to realize the EV workforce in Ohio. Through the collaborative identification of the 17 initiatives detailed above, we've also inventoried actual and potential funding sources to maximize impact through quick and successful implementation of key initiatives.

Maximizing resources is critical with many priorities across all potential funding sources that could dilute efforts – thus, we're amplifying what we heard throughout our interviews and workshops: **a braided funding strategy that blends state and federal investments for programs** is essential to Ohio's ability to successfully deliver our EV workforce ambition. This will not be simple but will provide an opportunity for us to act with focus and intentionality early, ensuring that every component is undertaken.

Throughout the Summer of 2023, we will form Ohio's statewide EV industry sector partnership and charter our regional nodes. This organizational structure will then work to identify key initiatives that can produce demonstrable progress and have measurable outcomes. By leading with impact, we will then map efforts to available funding sources, braiding together key existing state programs, like TechCred and IMAP that support job seekers to acquire short-term credentials to bolster workforce readiness, or Ohio Technical Centers (OTCs) that provide post-secondary career education at 52 sites across the state.

The current proposal for the Governor's biennial budget also contains significant investments in preparing Ohio's workforce for electrification, including:

- Hundreds of millions of dollars that can be leveraged for EV-related initiatives over two years
- 8 new or expanded programs that have demonstrated effectiveness
- 88 counties of impact to touch every Ohioan with EV opportunity

These funds will be critical to success over the next two years as we pair them with long-standing federal programs dedicated to workforce development, such as WIOIA and new efforts designed to ensure personal prosperity, such as the American Jobs Act. This braiding, which will have to be specific for each initiative, will be essential to ensuring the durability of the EV workforce strategy. On the next page, we've highlighted key funds that can be taken advantage of by state and local partners. Ohio's available state funds are pending passage of House Bill 33 and will be updated in July 2023 after the state operating budget has been signed into law.

Federal Funding

01

Building Pathways to Infrastructure Jobs Grant | \$200M

Summary – investment in public-private partnerships to develop, implement, and scale worker-centered sector strategy training programs. Funding opp. is part of IIJA

Timing – 2023 & 2024 application cycles

Type – Competitive

03

CHIPS Act | \$200M

Summary – Given the large overlap in occupations, skills, and competencies, the Creating Helpful Incentives to Produce Semiconductors and Science (CHIPS) Act has related workforce investments through the National Science Foundation

Timing – 5-years

Type – Various

02

Workforce Innovation & Opportunity Act | \$129M

Summary – WIOA's grants are designed to help job seekers access employment, education, training, and support services to succeed in the global labor economy

Timing – 4-year program cycle

Type – Formula

04

National Electric Vehicle Infrastructure Program | \$140M

Summary – NEVI provides funding to states to build out their EV charging station infrastructure, supporting operations, and ongoing maintenance. NEVI funding is part of IIJA.

Timing – 2022 - 2026

Type – Formula awarded to OH over 5 years



State Funding

01 Career Tech Equipment | \$100M

This budget request is to purchase equipment for career tech centers so students are trained on modern equipment they will encounter in the workplace.

02 Career Tech Expansion | \$200M

This budget request supports construction projects to establish or expand career technical education facilities.

03 Industry Sector Partnership Grants | \$15M

Expand reach of OMA-led Industry Sector Partnership's by funding the expansion of regional talent strategies.

04 TechCred | \$50M

This innovative training program reimburses employers who help employees earn industry-recognized, technology-focused credentials.

09 Super RAPIDS | \$200M

Summary– Expanding the Regionally Aligned Priorities in Delivering Skills (RAPIDS) program to support collaborative projects among qualifying institutions to strengthen education and training opportunities that maximize workforce development efforts in defined areas of the state
Timing– upcoming 2023
Type– Competitive

05 Industry-Recognized Credentials for High Schoolers | \$52M

Creating opportunities for students to earn industry-recognized credentials that put them on a pathway to success following graduation. Schools are eligible for reimbursements based on credentials earned by students.

06 WorkFORCE Ohio | \$60M

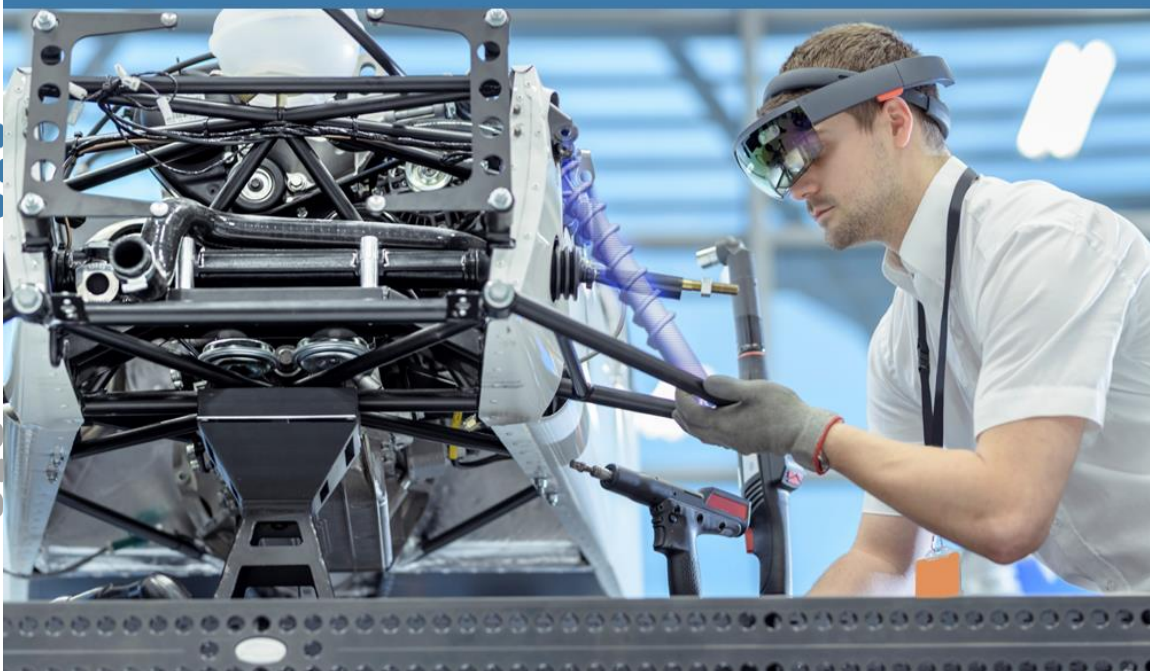
This initiative would fund a statewide analysis of current programs at higher ed institutions and tech centers, in addition to recommendations on ways of encouraging individuals to earn credentials and degrees needed to fill high-demand jobs.

07 EV Charging Infrastructure, EV Manufacturing, EV Battery Manufacturing | \$4M

Funding for the deployment of workforce training and credentialing programs tied to EV.

08 Internship Pilot Program | \$5M

Funding for an internship pilot program to connect career tech and college student with Ohio-based employers to facilitate work-based learning opportunities (e.g., internships, externships, and co-ops).



Investing in Action: Funding Alignment to Initiatives

The table below depicts an initial alignment of state and federal funding sources to the Ohio EV Workforce Strategy Initiatives.

| | Funding Level | | 01 | 02 | 03 | 04 | 01 | 02 | 03 | 04 | 05 | 06 | 07 | 08 | 09 |
|--|---|---------|----|----|----|----|----|----|----|----|----|----|----|----|----|
| | State | Federal | | | | | | | | | | | | | |
| OHIO EV WORKFORCE STRATEGY INITIATIVES | Initiative 1.1 – Mobilize EV industry partnership to manage EV workforce strategy | | ✓ | | ✓ | ✓ | | | ✓ | | | ✓ | | | ✓ |
| | Initiative 1.2 – Activate regional nodes with diverse partners to invest in pathways, training, and research | | ✓ | | ✓ | ✓ | | | ✓ | | | ✓ | | | ✓ |
| | Initiative 2.1 – Create and amplify new narratives around the EV industry and its career pathways | | | | ✓ | ✓ | | | ✓ | | | | | | |
| | Initiative 2.2 – Reimagine K-12 engagement to cultivate long-term EV talent pipelines | | | ✓ | | | | | | | ✓ | ✓ | ✓ | ✓ | ✓ |
| | Initiative 2.3 – Equip local career counselors, career centers and families to support EV careers | | | ✓ | | | | | | | | | | | |
| | Initiative 2.4 – Retain post-secondary graduates from Ohio institutions | | | | | | | | | | | | | ✓ | |
| | Initiative 3.1 – Broaden EV talent pipelines to currently incarcerated individuals and restored citizens | | ✓ | | | | | | | | | | ✓ | | |
| | Initiative 3.2 – Enhance engagement of underrepresented individuals through trusted partners | | ✓ | ✓ | | | | | | | | | ✓ | | ✓ |
| | Initiative 3.3 – Design training programs specific to underserved communities | | ✓ | | | | | | | ✓ | | | ✓ | | ✓ |
| | Initiative 3.4 – Provide wraparound services and supports to underserved communities | | | ✓ | | | | | | | | | | | |
| | Initiative 4.1 – Align and share stackable, EV-relevant advanced manufacturing curricula and credentials statewide | | | ✓ | | | | | | | | | ✓ | | ✓ |
| | Initiative 4.2 – Develop and provide upskilling for all career levels at all entry points | | ✓ | ✓ | | ✓ | | | | ✓ | | | ✓ | | ✓ |
| | Initiative 4.3 – Grow and optimize EV faculty and trainers in Ohio to make learnings available for all | | | | | | | | | | | | ✓ | | |
| | Initiative 4.4 – Coordinate regional training collaboratives to maximize faculty and resources | | | | | | ✓ | ✓ | | | | ✓ | ✓ | | ✓ |
| ✓ Potential Funding Opportunity | | | | | | | | | | | | | | | |

Conclusion

Ohio will continue leading the advanced manufacturing economy by investing in our greatest asset – our workforce of today and tomorrow. To do so, we must be prepared for the electric vehicle industry to supercharge our economy through the development of an anticipated 25k+ new jobs by 2030. These roles will span EV manufacturing and maintenance, battery development, and charging station installation and operations roles, all with a multitude of opportunities for entry through education and training pathways.

To meet this projected growth trajectory for EV occupations across Ohio, *Supercharging our EV Workforce | A roadmap for unlocking the future of advanced manufacturing* outlines a path forward to **develop and scale a resilient EV workforce that will evolve at the pace of innovation and affirm Ohio as an advanced manufacturing powerhouse for the new energy economy.**

This strategy is data-driven and coalition-informed, as over 70+ organizations were engaged across the state with an EV Workforce Strategy Leadership Team that was established to co-create and validate a list of in-demand EV occupations, a core competency model, mapping of existing education and training infrastructure, analysis of that infrastructure, and development of strategies to close talent supply gaps.

Our approach is centered around organizing for impact, as the state **activates a statewide EV industry sector partnership that operates in close collaboration with our regional partners**, who will be responsible for implementing on-the-ground strategies and actions. Ohio will:

- **Drive EV Industry Desirability & Career Awareness:** redefine EV careers to appeal to the next generation of Ohioans and ensure we attract and retain talent in the state that will be vital to the growth of the advanced manufacturing sector, broadly, and the EV industry-specifically
- **Broaden the EV Workforce Talent Pool:** redouble our recruiting efforts to tap talent in new ways to give all Ohioans a pathway to economic prosperity
- **Scale Education & Training to Meet EV Demand:** create, expand, and scale an educational and training ecosystem essential for a leading EV workforce

We look forward to creating greater alignment on statewide and regionally specific roles to enable our workforce strategy and initiatives to mobilize Ohio in the summer of 2023.

Together, we will develop regional EV coalitions, implement and refine our strategies to maximize impact, steward funding for optimal impact, and support those that will turn this strategy into action.

The Authors & Acknowledgements

About the Authors

The Ohio Governor's Office of Workforce Transformation, Ohio Manufacturers' Association, and Accenture partnered to design the statewide strategy: *Supercharging our Electric Vehicle Workforce* that will help Ohio-based automotive and manufacturing industries obtain the skilled talent needed to create a future-ready workforce and position Ohio as a leader in electrification.

Governor's Office of Workforce Transformation

The Governor's Office of Workforce Transformation (OWT) sets the strategy for workforce development in Ohio and coordinates with Ohio's state agencies and partners that impact the workforce. Led by Lt. Governor Jon Husted, OWT works closely with the Governor's Executive Workforce Board, state partners, and local communities to meet the needs of job seekers and businesses. OWT's mission is to connect Ohio's business, training, and education communities to build a dynamically skilled, productive, and purposeful workforce. Visit us at Workforce.Ohio.gov

Ohio Manufacturers' Association

For more than 100 years, the OMA has helped Ohio's manufacturers succeed and grow. OMA members work together to create global competitive advantage for Ohio manufacturing and enhance the quality of life across the state. Today, the OMA is supporting the evolution of modern manufacturing as Ohio companies adapt to global competition by creating and applying innovative technologies. Visit us at www.ohiomfg.com

Accenture

Accenture is a leading global professional services company that helps the world's leading businesses, governments and other organizations build their digital core, optimize their operations, accelerate revenue growth and enhance citizen services—creating tangible value at speed and scale. We are a talent and innovation led company with 738k people serving clients in more than 120 countries. Technology is at the core of change today, and we are one of the world's leaders in helping drive that change, with strong ecosystem relationships. We combine our strength in technology with unmatched industry experience, functional expertise and global delivery capability. We are uniquely able to deliver tangible outcomes because of our broad range of services, solutions and assets across Strategy & Consulting, Technology, Operations, Industry X and Accenture Song. These capabilities, together with our culture of shared success and commitment to creating 360° value, enable us to help our clients succeed and build trusted, lasting relationships. We measure our success by the 360° value we create for our clients, each other, our shareholders, partners and communities. Visit us at www.accenture.com

Acknowledgements

We would like to thank the 70+ organizations that engaged with the team during the development of this strategy, namely those who contributed as part of the Ohio EV Workforce Strategy Leadership Team:

Ohio EV Workforce Strategy Leadership Team

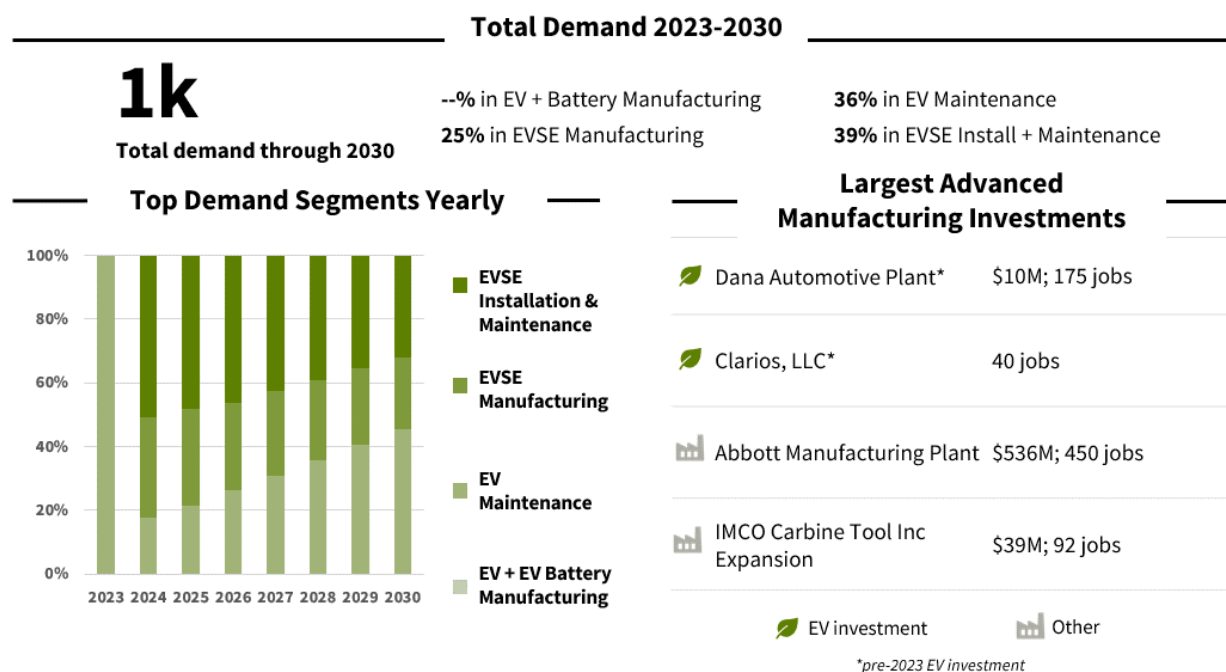
| | |
|--|--|
| ChargePoint | Association of Independent Colleges & Universities of Ohio (AICUO) – <i>University of Dayton</i> |
| ATS Ohio | |
| American Battery Solutions | Ohio Association of Community Colleges (OACC) - <i>Columbus State Community College</i> |
| Stellantis | Inter-University Council of Ohio (IUC) – <i>Youngstown State University</i> |
| Honda | |
| Ford | Ohio Technical Centers |
| Workhorse | Ohio Tech Net – <i>Lorain County Community College</i> |
| Foxconn | ChargerHelp! |
| Ultium | MAGNET |
| Workforce Connect Manufacturing Sector Partnership – <i>Lincoln Electric</i> | National Center for Urban Solutions |
| Mahoning Valley Manufacturers Coalition | Ohio Workforce Association |
| Ohio Association of Career Technical Superintendents (OACTS) - <i>Great Oaks Career Campuses</i> | JobsOhio |
| Ohio Department of Education | Ohio Department of Job & Family Services |
| Ohio Department of Higher Education | Ohio Department of Development (MEP's) |
| | DriveOhio |

Appendix A: Regional Placemats

See notes at end of this appendix for key callouts and assumptions of the data.

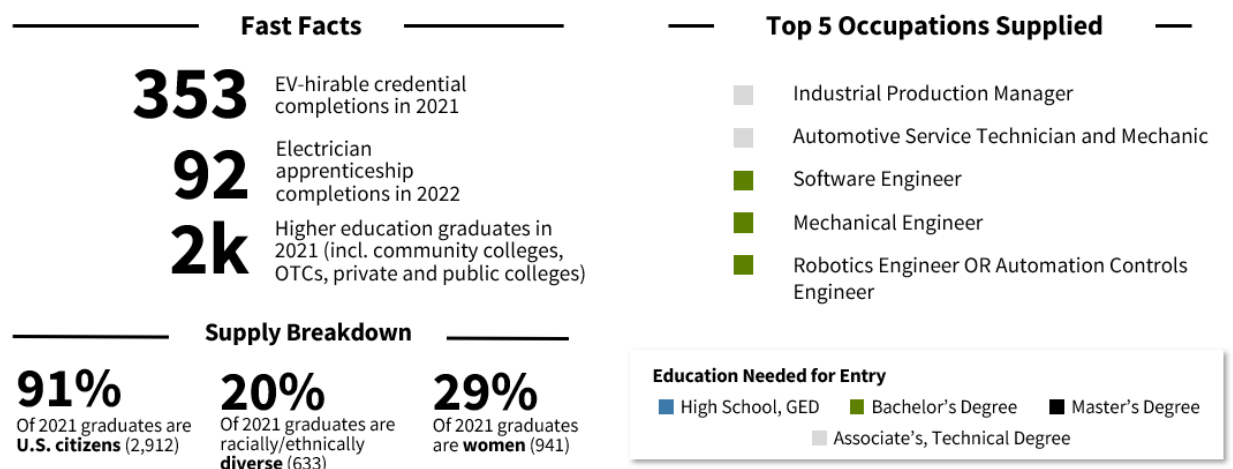
Northwest Ohio

Demand: The bulk of EV-related job growth in Northwest Ohio will be attributable to EV maintenance and EVSE installation and maintenance, with major EV-related manufacturing investments elsewhere in the state.



Supply: 2.4K EV-qualified individuals are project to come out of Northwest Ohio annually from credentials, apprenticeships, and higher education programs. NW Ohio programs are a substantial supplier of completions in associate's-level talent for both manufacturing and maintenance roles, such as industrial production managers and auto technicians.⁴²

⁴² Ibid.

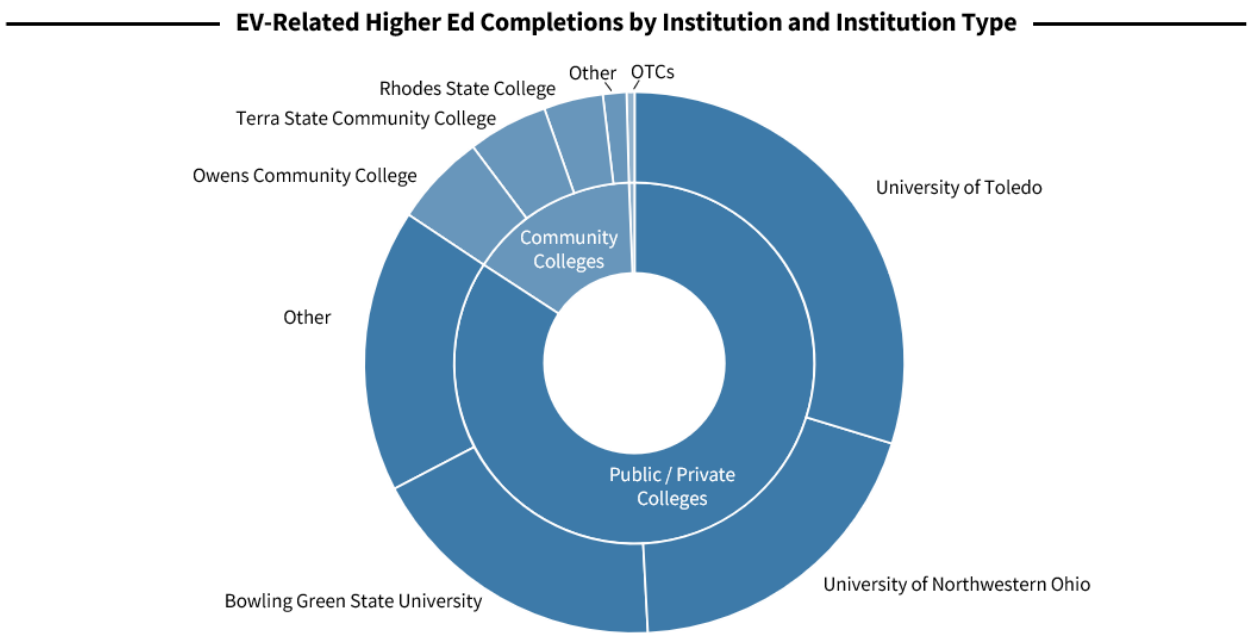


Education Landscape: Northwest Ohio has a diverse spread of four-year and community colleges producing EV-qualified graduates, with the University of Toledo and Owens Community College as key players. OTCs have room to grow throughput in the region, as well as completions by diverse individuals and women. ⁴³

| Top Industry-Recognized Credentials | | |
|-------------------------------------|---|-----|
| 01 | Industry Credential Assessment, NCCER Level 1 | 166 |
| 02 | Industry Credential Assessment, American Welding Society (AWS) - Certified Welder | 82 |
| 03 | Industry Credential Assessment, Fanuc - Handling Tool Operation & Programming J2P0310 IACT Approved | 20 |

| Top Institutions by EV-Related Completions | | | | | |
|--|-----------------|------------|-----------|--------------------|-------|
| | Total Graduates | US Citizen | Diversity | Non-Resident Alien | Women |
| Colleges and Universities | | | | | |
| University of Toledo | 942 | 762 | 155 | 180 | 254 |
| University of Northwestern Ohio | 613 | 597 | 183 | 16 | 63 |
| Bowling Green State University-Main Campus | 573 | 525 | 65 | 48 | 223 |
| Community Colleges | | | | | |
| Owens Community College | 176 | 172 | 43 | 4 | 64 |
| Terra State Community College | 151 | 151 | 27 | 0 | 40 |
| Rhodes State College | 112 | 112 | 9 | 0 | 49 |
| Ohio Technical Centers | | | | | |
| Apollo Career Center | 14 | 14 | 3 | 0 | 2 |

⁴³ Ibid.



Key Stakeholders and Education Spotlight: Northwest Ohio has a breadth of education programs tooled from community colleges and employer partnerships. As Northwest Ohio participates in a state-coordinated workforce strategy, these innovative education programs can serve as best-practice examples.

Key Stakeholders

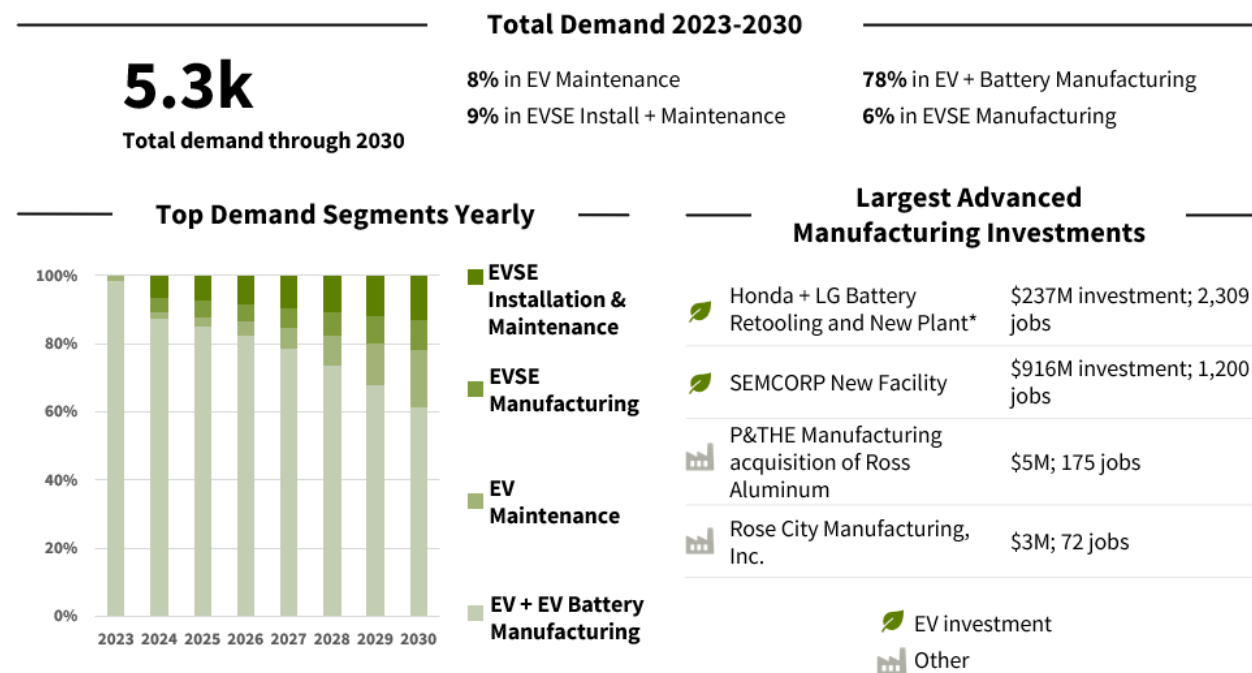
| | | | |
|---|--|--|---|
| Employers <ul style="list-style-type: none">StellantisClarios | Education <ul style="list-style-type: none">University of ToledoApollo Career CenterOwens Community CollegePenta Career CenterBowling Green State UniversityOhio Northern University | Workforce and Econ Development <ul style="list-style-type: none">RGP Northwest Ohio | ISPs <ul style="list-style-type: none">Adv. Manu. Consortium (AMC)Northwest Ohio Manufacturing Alliance (NOMA)Raise the Bar Hancock County |
|---|--|--|---|

Education Spotlight

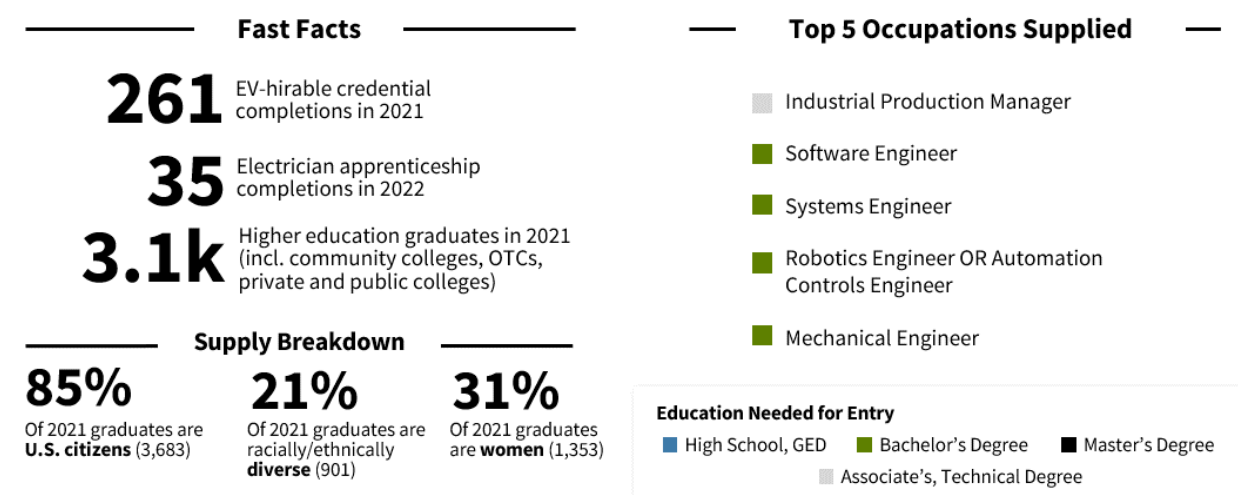
| | |
|---|--|
| Advanced Manufacturing Training Center Owens Community College <ul style="list-style-type: none">Vehicle Electric and Electronics course includes training in electrical theories and circuits. Includes lab experiences such as with the use of semiconductors and circuitsPartnered with Dana in 2019 to build a \$9.6M facility to make advanced manufacturing training and skilled trade programs more widely available in the region | Manufacturing Training & Workforce Development Tooling University <ul style="list-style-type: none">Non-profit workforce development organization that produces learning content for the manufacturing industryOffers 600 online and instructor-led courses, pre- and post-program skill evaluations to create individualized training, industry-recognized credentials (with online learning mapped to top certifications), and an apprenticeship framework for employers |
|---|--|

Western Ohio

Demand: Most job growth will occur in the EV + Battery Manufacturing space as large investments ramp up. With limited demand in maintenance and EVSE installation, the bulk of talent demand will be for manufacturing roles, such as engineers, equipment technicians, and credentialed operators.



Supply: 3.4K EV-qualified individuals are projected to come out of Western Ohio annually from credentials, apprenticeships, and higher education programs. In addition to EV, this supply will support all competing advanced manufacturing occupations. Therefore, supply of critical roles, such as engineers and equipment technicians for EV manufacturing, must be expanded to meet projected demand.⁴⁴



⁴⁴ Ibid.

Education Landscape: The University of Dayton and Wright State University provide nearly half of the EV-relevant degree graduates. Community colleges - particularly Sinclair - provide about a third of EV-relevant degree graduates. Western Ohio has room to grow in OTC throughput, and training programs should focus their recruitment efforts on expanding workforce diversity.⁴⁵

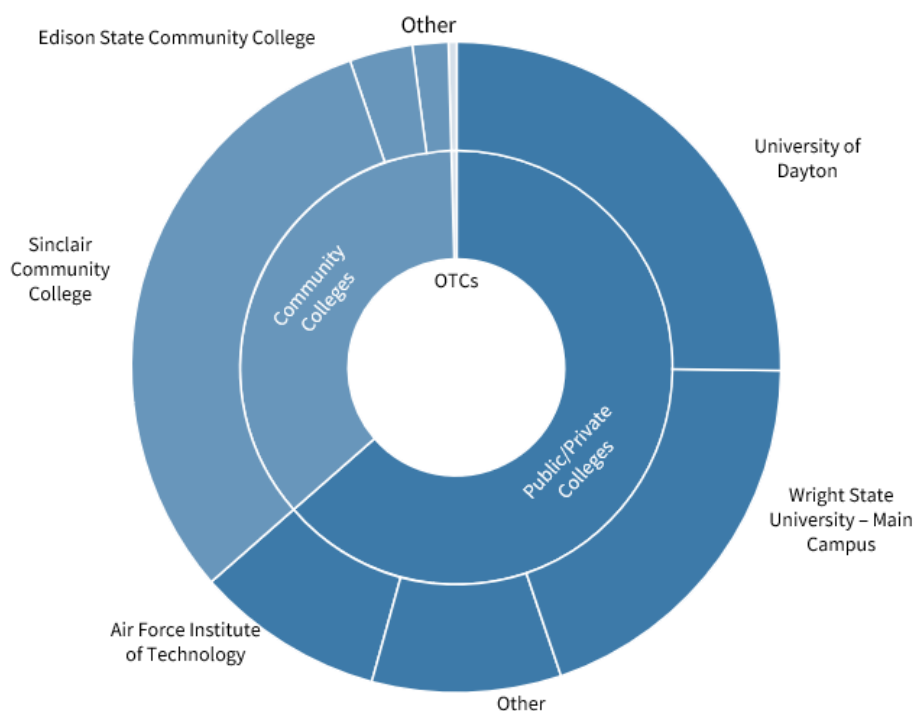
Top Industry-Recognized Credentials

| | | |
|----|---|----|
| 01 | Industry Credential Assessment, NCCER Level 1 | 96 |
| 02 | Industry Credential Assessment, Fanuc - Handling Tool Operation & Programming J2P0310 IACT Approved | 71 |
| 03 | AWS Welder Qualification Industry Credential Assessment | 35 |

Top Institutions by EV-Related Completions

| | Total Graduates | US Citizen | Diversity | Non-Resident Alien | Women |
|---|-----------------|------------|-----------|--------------------|-------|
| Colleges and Universities | | | | | |
| University of Dayton | 1,085 | 643 | 106 | 442 | 303 |
| Wright State University-Main Campus | 848 | 731 | 161 | 117 | 280 |
| Air Force Institute of Technology-Graduate School of Engineering & Management | 405 | 396 | 100 | 9 | 55 |
| Community Colleges | | | | | |
| Sinclair Community College | 1,341 | 1,291 | 389 | 50 | 458 |
| Edison State Community College | 136 | 136 | 11 | 0 | 75 |
| Clark State Community College | 77 | 77 | 22 | 0 | 42 |
| Ohio Technical Centers | | | | | |
| Miami Valley Career Technology Center | 17 | 17 | 0 | 0 | 0 |

EV-Related Higher Ed Completions by Institution and Institution Type



⁴⁵ Ibid.

Key Stakeholders and Education Spotlights: Western Ohio has a vibrant mix of employers, education providers, and workforce and industry partnerships. Within the state-coordinated workforce strategy, Western Ohio should leverage its institutional diversity among higher education partners to amplify the impact of pathway innovation for the state.

Key Stakeholders

| | | | |
|--|---|---|--|
| <i>Employers</i> <ul style="list-style-type: none">American Battery SolutionsSEMCORPNavistarHondaLG Energy Solution | <i>Education</i> <ul style="list-style-type: none">University of DaytonSinclair Community CollegeMiami Valley Career and Tech CenterClark State Community CollegeGreene County Career Center | <i>Workforce and Econ Development</i> <ul style="list-style-type: none">Dayton Area Chamber of CommerceDayton Development Coalition | <i>ISPs</i> <ul style="list-style-type: none">Dayton Region Manufacturing PartnershipWest Central Ohio Manufacturing Partnership |
|--|---|---|--|

Education Spotlight

ZEV Education and Awareness Grant Sinclair Community College

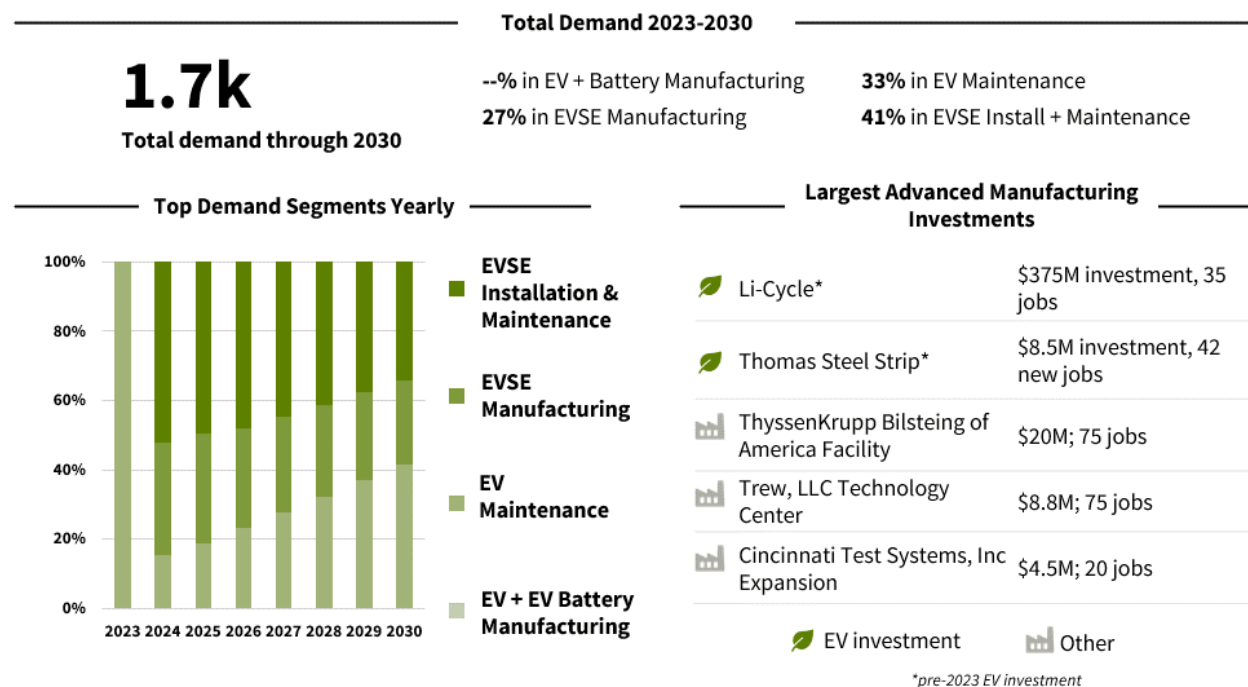
- SCC is developing programming to address shortages in aftermarket professionals able to repair and maintain EVs. The grant, funded by Electrify America, will fund training for 56 incumbent automotive tech workers, Junior Visit Days to expose high schoolers to EV technology, and two public Q&A sessions with EV demonstrations

Tesla START Program Sinclair Community College

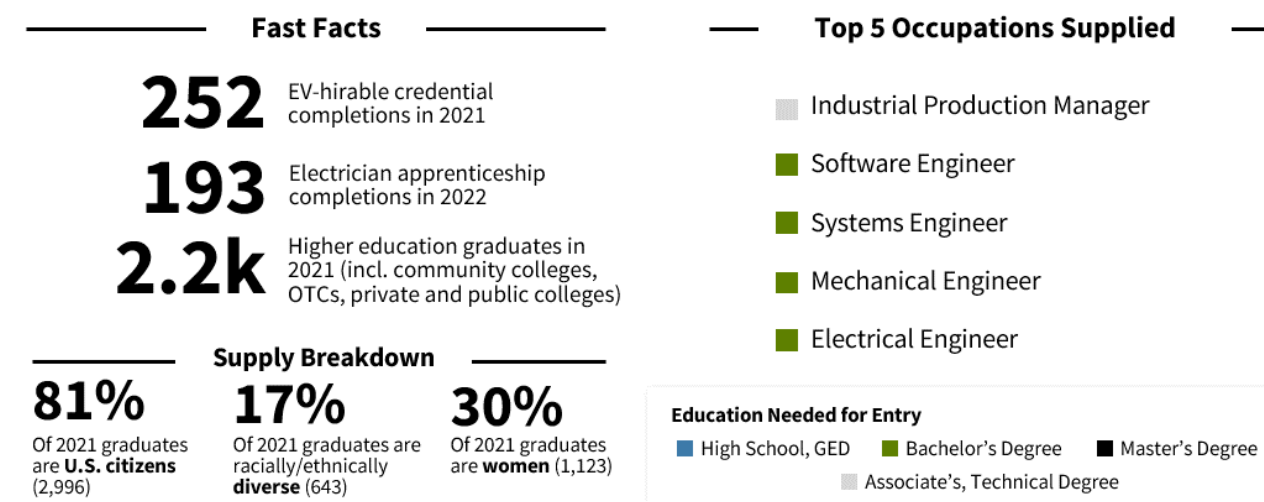
- START is Tesla's official career training program for educating professionals on servicing Tesla vehicles. Tesla pays students for their participation and provides the instructor, curriculum, training equipment, vehicles, and tools
- Sinclair is the only community college in the Midwest to offer Tesla START

Southwest Ohio

Demand: The bulk of EV-related job growth in Southwest Ohio will be attributable to EV maintenance and EVSE installation and maintenance, with major EV-related manufacturing investments elsewhere in the state.



Supply: 2.7k EV-qualified individuals are projected to come out of Southwest Ohio annually from credentials, apprenticeships, and higher ed programs. In addition to EV, this supply will support all competing advanced manufacturing occupations elsewhere in the state.⁴⁶



⁴⁶ Ibid.

Education Landscape: The University of Cincinnati supplies most of all EV-related graduates across education level and occupation. There is room to grow community college and technical center throughput for EV-relevant higher education programs.⁴⁷

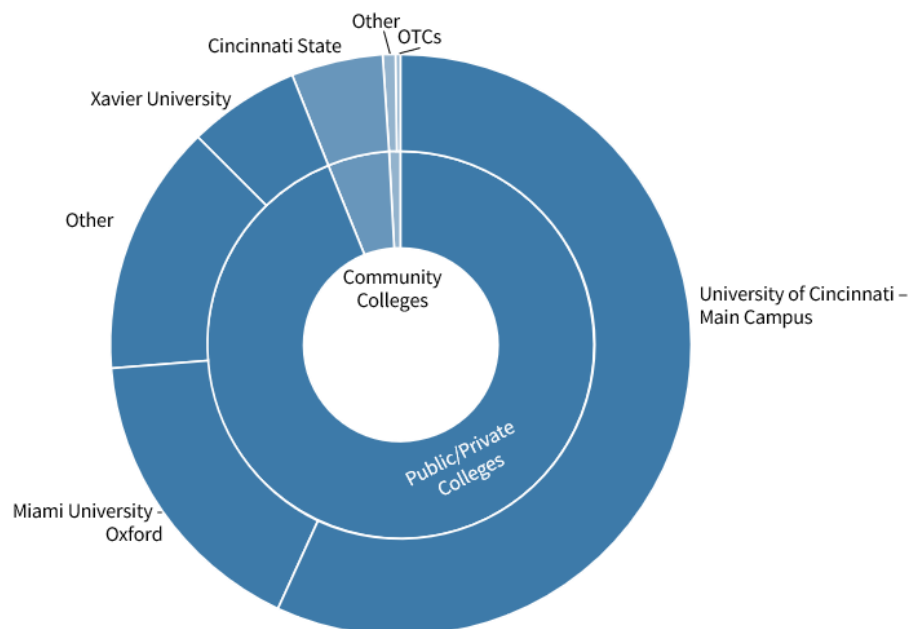
Top Industry-Recognized Credentials

| | | |
|----|---|-----|
| 01 | Industry Credential Assessment, NCCER Level 1 | 107 |
| 02 | Industry Credential Assessment, American Welding Society (AWS) - Certified Welder | 66 |
| 03 | AWS Welder Qualification Industry Credential Assessment | 36 |

Top Institutions by EV-Related Completions

| | Total Graduates | US Citizen | Diversity | Non-Resident Alien | Women |
|--|-----------------|------------|-----------|--------------------|-------|
| Colleges and Universities | | | | | |
| University of Cincinnati-Main Campus | 2,099 | 1,552 | 308 | 547 | 653 |
| Miami University-Oxford | 617 | 499 | 88 | 118 | 155 |
| Xavier University | 226 | 223 | 43 | 3 | 69 |
| Community Colleges | | | | | |
| Cincinnati State Technical and Community College | 189 | 174 | 77 | 15 | 72 |
| Ohio Technical Centers | | | | | |
| Butler Technology and Career Development Schools | 25 | 25 | 3 | 0 | 1 |
| Great Oaks Career Campuses | 12 | 12 | 9 | 0 | 0 |

EV-Related Higher Ed Completions by Institution and Institution Type



⁴⁷
Ibid.

Key Stakeholders and Education Spotlight: Southwest Ohio is home to EV-related employers and innovative education programs. Although the largest EV-related investments lie in other counties, stakeholders in the region should be considered as important suppliers of talent for the state as a whole.

Key Stakeholders

Employers

- Li-Cycle
- Workhorse
- Thomas Steel Strip
- Edge Energy
- Electrada

Education

- Cincinnati State Technical & Community College
- University of Cincinnati
- Butler Tech

Workforce and Econ Development

- REDI Cincinnati
- Supply Chain OKI

ISPs

- Advanced Manufacturing Industry Partnership (AMIP)

Education Spotlight

Electric Drive Mechanisms Course Cincinnati State Technical & Community College

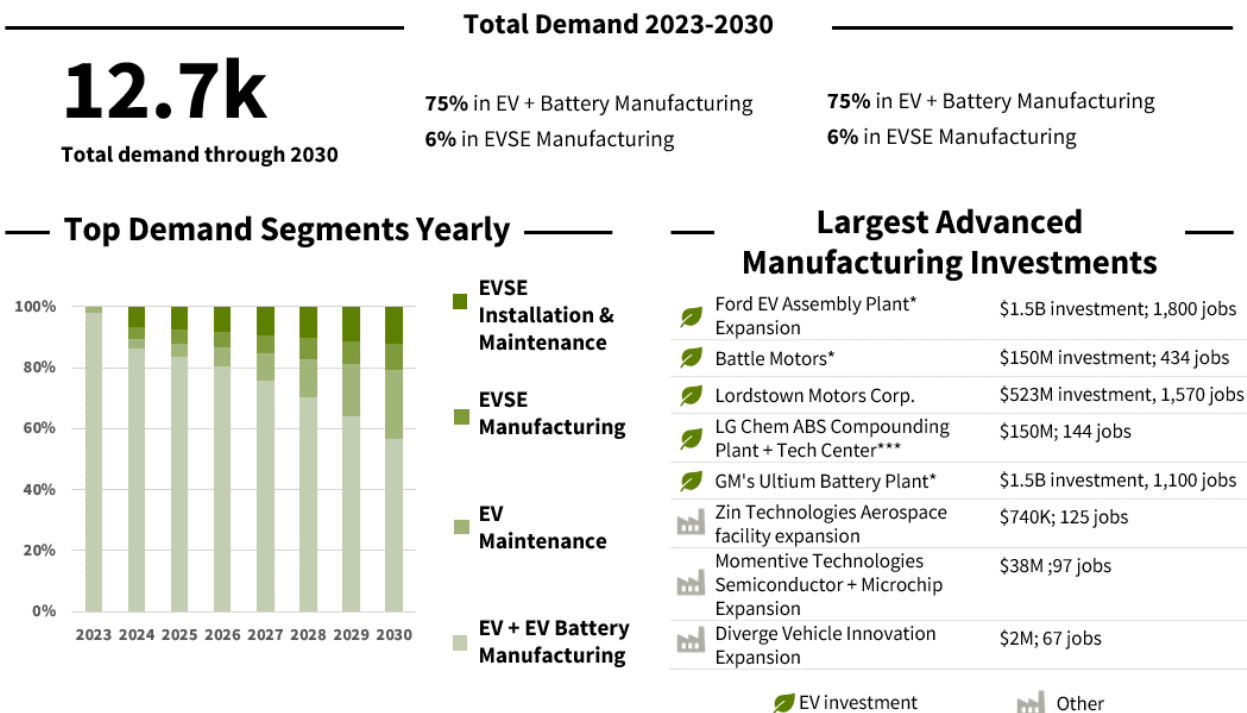
- Offers a 3-credit E-drive mechanisms course that covers power + energy measurement, energy storage, battery monitoring, control electronic, and electrical safety device topics
- Also offers multiple advanced manufacturing certificate + credentialing programs (e.g., CNC machine tool operator, Mechanical Engineer Technology)

EV Racecar Team University of Cincinnati

- UC's 40 student EV racing team (sponsored by Blink Charging) participates in Formula SAE's annual collegiate design competition
- The organization's goal is to teach students about sustainable technology development, particularly as it pertains to transportation
- UC also exposes students to EVs through their installed EV chargers on campus

Northeast Ohio

Demand: Job growth for Northeast Ohio will primarily be in the EV + Battery Manufacturing space. By 2030, only about 30% of job opportunities will be in EV or EVSE maintenance. Emphasis on manufacturing job growth indicates there will be strong demand in roles such as engineers, safety, production, managers, and technician roles.



Education Landscape: Northeast Ohio's EV-related degree graduates are supplied by a diverse spread of community colleges and four-year institutions, with Cleveland State University, University of Akron - Main Campus, Stark State College, and Lorain County Community College all key players. OTCs have stronger throughput than other regions, but still account for a minority of grads.⁴⁹

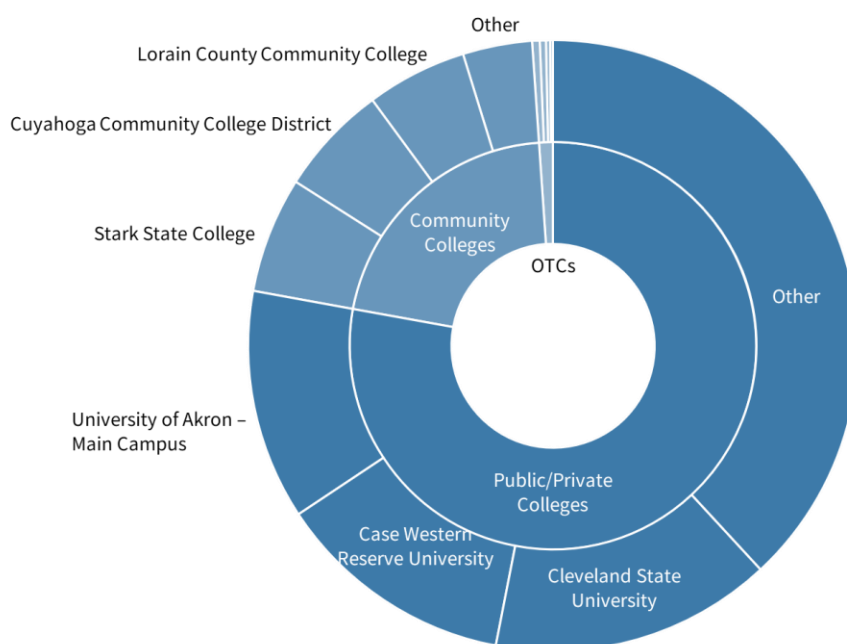
Top Industry-Recognized Credentials

| | | |
|----|---|-----|
| 01 | Industry Credential Assessment, American Welding Society (AWS) - Certified Welder | 271 |
| 02 | Industry Credential Assessment, NCCER Level 1 | 229 |
| 03 | AWS Welder Qualification Industry Credential Assessment | 83 |

Top Institutions by EV-Related Completions

| | Total Graduates | US Citizen | Diversity | Non-Resident Alien | Women |
|-------------------------------------|-----------------|------------|-----------|--------------------|-------|
| Colleges and Universities | | | | | |
| Cleveland State University | 876 | 702 | 178 | 174 | 876 |
| Case Western Reserve University | 746 | 533 | 184 | 213 | 746 |
| University of Akron - Main Campus | 714 | 621 | 123 | 93 | 714 |
| Community Colleges | | | | | |
| Stark State College | 359 | 359 | 70 | 0 | 97 |
| Cuyahoga Community College District | 345 | 331 | 121 | 14 | 78 |
| Lorain County Community College | 312 | 306 | 82 | 6 | 131 |
| Ohio Technical Centers | | | | | |
| Polaris Career Center | 19 | 19 | 6 | 0 | 19 |
| EHOVE Career Center | 12 | 12 | 0 | 0 | 12 |
| Madison Adult Career Center | 10 | 10 | 0 | 0 | 10 |

EV-Related Higher Ed Completions by Institution and Institution Type



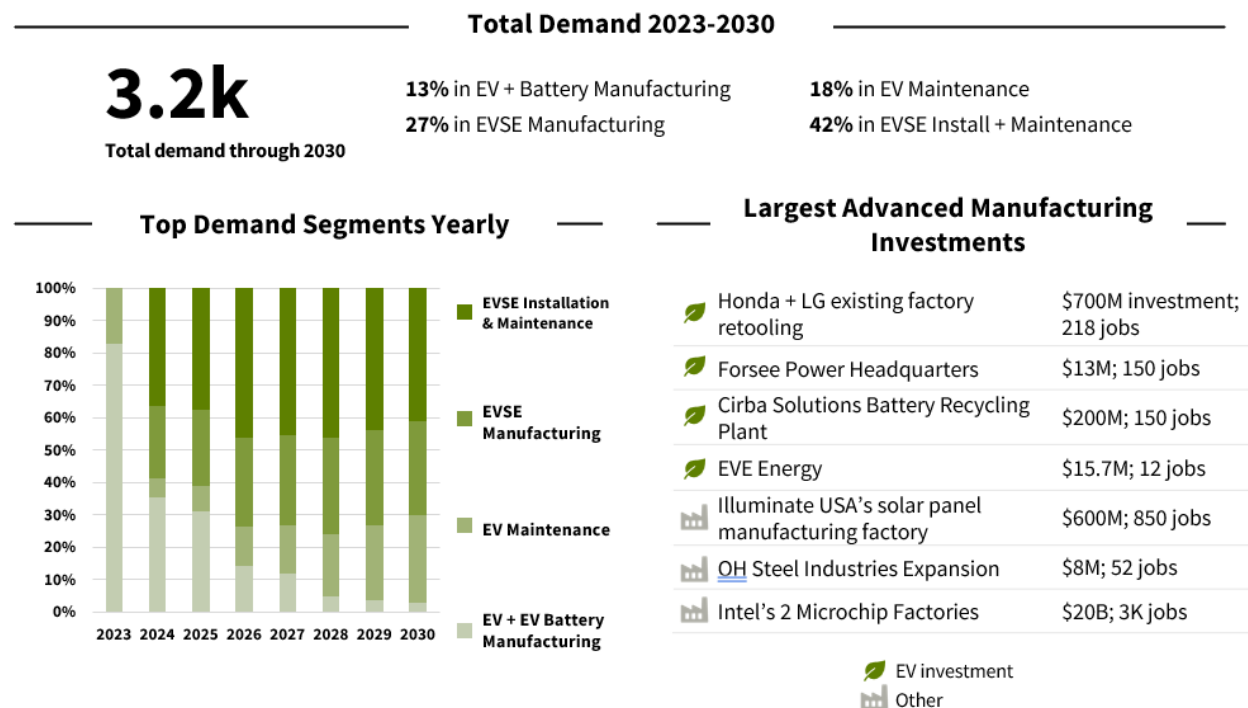
⁴⁹ Ibid.

Key Stakeholders and Education Spotlight: Northeast Ohio has a diverse spread of employers, education providers, and workforce- and industry-related partnerships, along with key major investments in EV, such as Ultium Cells and Foxconn. Northeast Ohio should leverage its education partners' innovative programs to help industry drive curriculum alignment in the state.

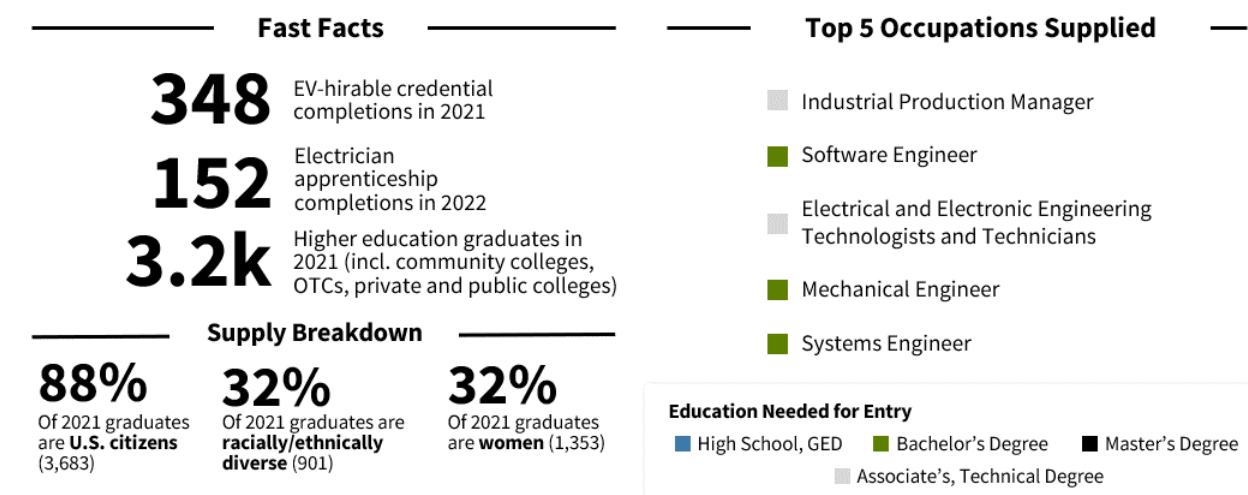
| Key Stakeholders | | | |
|--|--|--|--|
| Employers <ul style="list-style-type: none">• Battle Motors• Ultium Cells• Foxconn• Ford | Education <ul style="list-style-type: none">• Lorain County Community College• Polaris Career Center• Youngstown State University• Cleveland State University• Case Western Reserve University• Cuyahoga Community College (Tri-C) | Workforce and Econ Development <ul style="list-style-type: none">• TeamNEO | ISPs <ul style="list-style-type: none">• Workforce Connect• Mahoning Valley Manufacturers Coalition (MVMC)• ConxusNEO• Stark County Manufacturing Sector Partnership• Manufacturing Works / LCMSF• Alliance for Working Together (AWT) |
| Education Spotlight | | | |
| Existing + Upcoming EV-relevant Programs Youngstown State University <ul style="list-style-type: none">• Multiple EV-relevant + Advanced Manufacturing programs• Announced an Energy Storage Workforce Innovation Center in collaboration with Dept. of Energy's Oak Ridge National Lab in '21• Announced an EV workforce training and innovation center in collaboration with Foxconn in '22 | | Automotive Technology Program Mahoning County Career + Technical Center <ul style="list-style-type: none">• Instructs post-high school learners on gas + EV basics and partners with ASE for hands-on EV maintenance training• Recently broke ground on an Innovative Energy + Technology Workforce Center, where additional EV-centered training will be housed | |

Central Ohio

Demand: Immediate job growth will occur in the EV + Battery Manufacturing space as large investments materialize. However, EVSE Install + Maintenance quickly takes over as the largest source of job creation, highlighting a need for apprentice-level electricians and electrical technicians.



Supply: 3.7k EV-qualified individuals are projected to come out of Central Ohio annually from credentials, apprenticeships, and higher ed programs. In addition to EV, this supply will support all competing advanced manufacturing occupations. Supply of critical roles, such as electricians for EVSE installation and maintenance, must be expanded to meet projected demand.⁵⁰



⁵⁰ Emsi Burning Glass (now Lightcast) (2023), "[Full School Listing](#)," Lightcast – lightcast.io.

Education Landscape: The Ohio State University supplies nearly half of EV-relevant degree graduates, with Franklin University following. Central Ohio should look to expand OTC and community college throughput to meet talent needs, and OEMs and training programs should focus their recruitment efforts on expanding diversity and inclusion in the workforce.

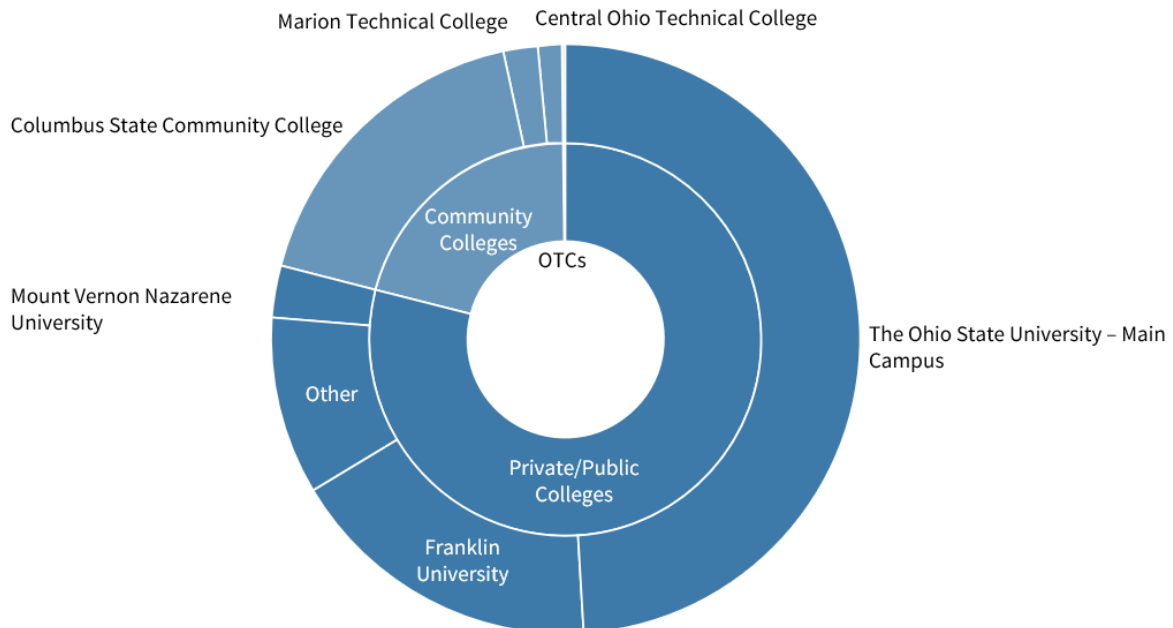
Top Industry-Recognized Credentials

| | | |
|----|---|----|
| 01 | Fanuc - Handling Tool Operation & Programming J2P0310 IACT Approved | 88 |
| 02 | American Welding Society (AWS) - Certified Welder | 68 |
| 03 | Motoman DX100 Basic Programming w/Material Handling | 56 |

Top Institutions by EV-Related Completions

| | Total Graduates | US Citizen | Diversity | Non-Resident Alien | Women |
|---|-----------------|------------|-----------|--------------------|-------|
| Colleges and Universities | | | | | |
| The Ohio State University - Main Campus | 2,395 | 1,854 | 580 | 541 | 617 |
| Franklin University | 852 | 825 | 456 | 27 | 376 |
| Mount Vernon Nazarene University | 142 | 142 | 32 | 0 | 51 |
| Community Colleges | | | | | |
| Columbus State Community College | 859 | 849 | 311 | 10 | 33 |
| Marion Technical College | 91 | 91 | 13 | 0 | 251 |
| Central Ohio Technical College | 64 | 63 | 15 | 1 | 40 |
| Ohio Technical Centers | | | | | |
| Eastland - Fairfield Career and Technical Schools | 10 | 10 | 6 | 0 | 0 |

EV-Related Higher Ed Completions by Institution and Institution Type



Key Stakeholders and Education Spotlight: Central Ohio has a strong presence of employers in the EV space, along with multiple workforce, education, and industry partnerships able to mobilize around EV. As Central Ohio develops a state-coordinated workforce strategy, these key stakeholders should be considered and innovative education programs should be capitalized upon.⁵¹

Key Stakeholders

| | | | |
|--|--|---|---|
| Employers <ul style="list-style-type: none">• Cirba Solutions• Forsee Power• Honda• Volkswagen• EVE Energy• ATS Automation• ChargePoint | Education <ul style="list-style-type: none">• Eastland-Fairfield Career & Tech• Columbus State Community College• OSU Center for Automotive Research• Tolles Career & Technical Center• Delaware Area Career Center• Ohio Hi-Point Career Center• C-Tec of Licking County | Workforce and Econ Development <ul style="list-style-type: none">• OneColumbus | ISPs <ul style="list-style-type: none">• Central Ohio Manu. Partnership (COMP) |
|--|--|---|---|

Education Spotlight

NCUS Tec

National Center for Urban Solutions

- State-assisted institution that offers 50+ high-tech, in-demand credentialed programs, including EV-relevant training such as software development, FANUC handling tool operations & programming
- Some programs offer scholarships through IMAP and Franklin County Economic Office

Electro-Mechanical Engineering Technology

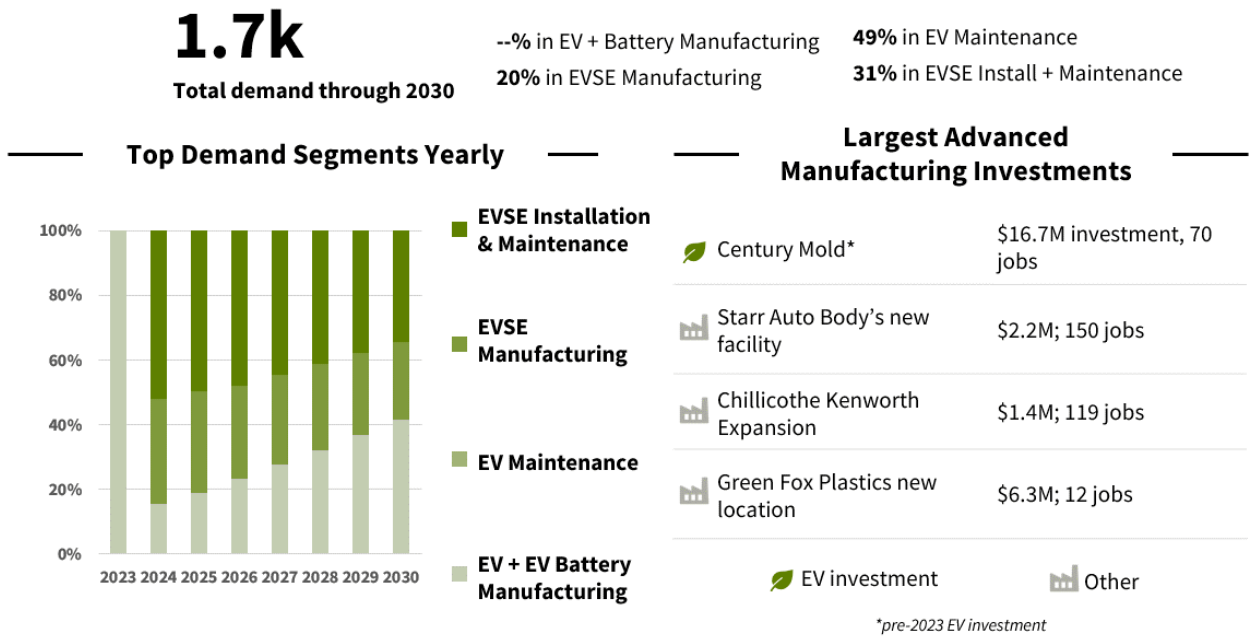
Columbus State Community College

- 62 credit hour degree program that combines Columbus State's Mechanical Engineering Technology and Electronics Engineering Technology programs
- Specifically identified as a training opportunity for jobs in advanced manufacturing, including new Intel semiconductor sites

⁵¹ Ibid.

Southeast Ohio

Demand: The bulk of EV-related job growth in Southeast Ohio will be attributable to EV maintenance and EVSE installation and maintenance, with major EV-related manufacturing investments elsewhere in the state.

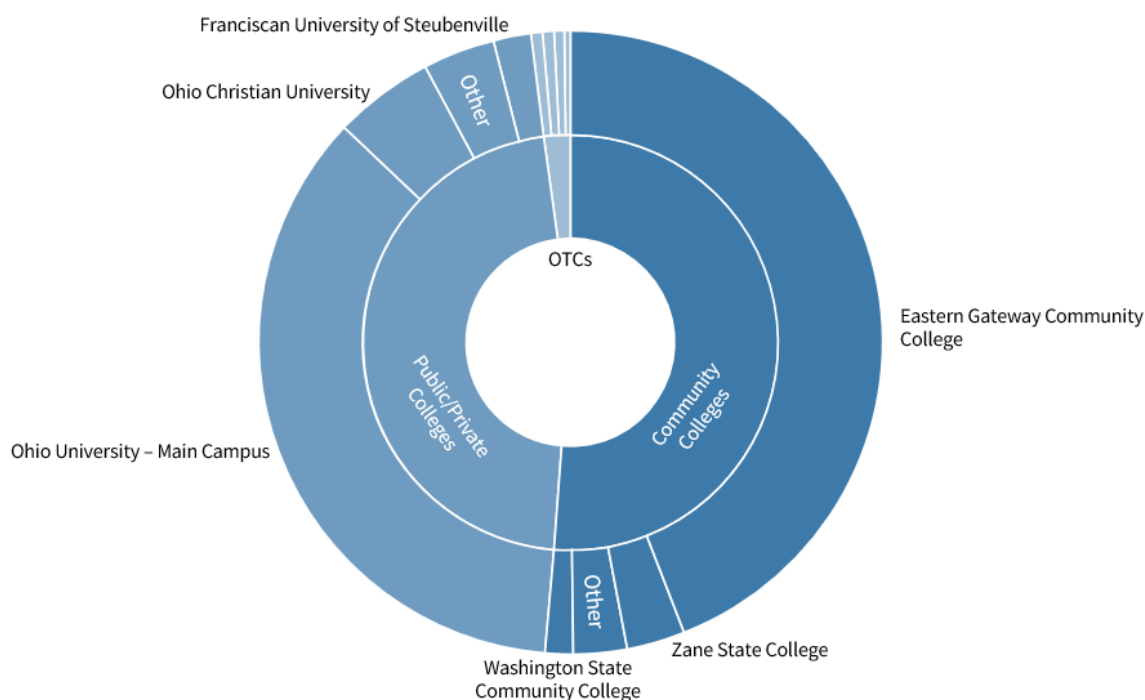


Education Landscape: Nearly half of the EV-qualified completions in Southeast Ohio are attributable to Ohio University. The other biggest contributor to EV-qualified completions is Eastern Gateway Community College (EGCC). These completions disproportionately represent women and gender minorities at a greater rate compared to other regions in the state. However, it is important to note that the majority of EGCC students are virtual, with only 14% being from Ohio. 25% of EGCC graduates live in Ohio post-grad, which materially contributes to the EV workforce supply in Ohio.

Top Institutions by EV-Related Completions

| | Total Graduates | US Citizen | Diversity | Non-Resident Alien | Women |
|---------------------------------------|-----------------|------------|-----------|--------------------|-------|
| Colleges and Universities | | | | | |
| Ohio University-Main Campus | 1,259 | 1,195 | 213 | 64 | 430 |
| Ohio Christian University | 184 | 182 | 75 | 2 | 108 |
| Franciscan University of Steubenville | 70 | 70 | 8 | 0 | 16 |
| Community Colleges | | | | | |
| Eastern Gateway Community College | 1,550 | 1,550 | 650 | 0 | 1,015 |
| Zane State College | 107 | 107 | 10 | 0 | 38 |
| Washington State Community College | 51 | 51 | 4 | 0 | 18 |
| Ohio Technical Centers | | | | | |
| O C Collins Career Center | 21 | 21 | 0 | 0 | 1 |
| Mid-East CTC-Adult Education | 18 | 18 | 4 | 0 | 1 |
| Scioto County Career Technical Center | 12 | 12 | 0 | 0 | 1 |

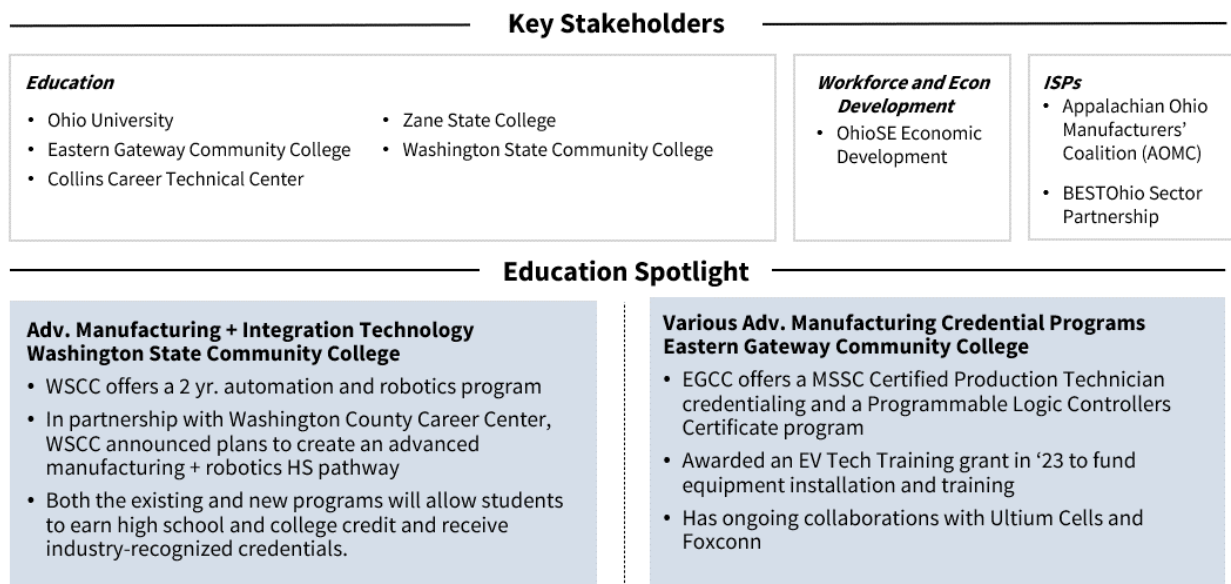
EV-Related Higher Ed Completions by Institution and Institution Type



Top Industry-Recognized Credentials

| | | |
|----|---|-----|
| 01 | Industry Credential Assessment, NCCER Level 1 | 107 |
| 02 | Industry Credential Assessment, American Welding Society (AWS) - Certified Welder | 66 |
| 03 | AWS Welder Qualification Industry Credential Assessment | 36 |

Key Stakeholders and Education Spotlight: Southeast Ohio has the most diverse completions in the state for women. For statewide workforce initiatives, SE Ohio will serve as an innovation powerhouse of inclusionary tactics. The region has fewer workforce and economic development partners than other parts of the state, so fostering these types of partnerships can be considered to strengthen the regions presence in the electrification industry.



Some key notes for this section include:

- EV-hirable is defined as credentials that are likely to qualify an individual for an EV occupation.
- Higher education graduate supply number includes drain from (i) students emigrating from Ohio post-graduation and (ii) students choosing a career path un-related to their degree of study.
- “Diversity” refers to individuals who are African American, Hispanic, Asian, American Indian, or are of multiple or unknown race/ethnicity.

Appendix B: EV-Relevant Programs in Ohio

EV-Relevant Education Programs*

The list below showcases some of the EV education programs, EV-relevant advanced manufacturing education programs, and EV-relevant advanced manufacturing credentials available from Ohio institutions.

Target demographic:

- 

Alternative Energy Pathway
-  K-12
  Non-Degree Professionals
-  Higher Education
  Career Technical Education

Alternative Energy Pathway Toledo Technology Academy

The program intends to train high school students, people who are currently auto mechanics seeking upskilling, and members of the Toledo community in electric vehicle education programming

Auto Technology Program Mahoning County Career and Technical Center

MCCTC broke ground on an Innovative Energy and Technology Workforce Training Center as an expansion of its Energy Technology and Workforce Training Center, where additional EV-centered training will be hosted

ASE EV Certification Columbus State Community College and Others

This program is aimed to prepare students with knowledge about diagnosis and repair of alternative energy engines, fuel systems and computer systems. Key competencies attained include how to employ self-teaching techniques to keep up with technological advancements

EVITP

EVITP is a certification program for electricians in the US and Canada for the installation of EVSE equipment. The training is backed by a collaboration of industry stakeholders, such as automakers, EVSE manufacturers, educational institutions, utility companies, and electrical industry professionals. It is a required certification for NEVI-funded chargers

EV Tech Training Eastern Gateway Community College

EGCC received \$914K in federal funding for electric vehicle technology training

EV Training Center Youngstown State University

YSU plans to design and launch a national electric vehicle workforce training and innovation center. The center will focus on helping scale the EV workforce around advanced manufacturing, energy storage, and other integrated tech solutions

Hybrid EV Systems Sinclair Community College

In 2022, Sinclair received a \$602K NSF grant for electric vehicle training and for the development of a certificate program for skills needed to service EVs, and today hosts a HEV Systems course

Smart Mobility Ambassador Program DriveOhio and participating high schools

YSU plans to design and launch a national electric vehicle workforce training and innovation center. The center will focus on helping scale the EV workforce around advanced manufacturing, energy storage, and other integrated tech solutions

Tesla START Program Sinclair Community College

START is Tesla's official career training program for educating professionals on servicing Tesla vehicles. The program offers the opportunity for a smooth transition to employment at Tesla by working with graduates to find job placement at a Tesla Service Center in North America

ZEV Education and Awareness Grant Sinclair Community College

SCC is developing programming to address shortages in aftermarket professionals able to repair and maintain EVs. The grant, funded by Electrify America, will provide training to 56 incumbent automotive tech workers, Junior Visit Days to expose high schoolers to EV technology, and two public Q&A sessions and EV demonstrations

EV-Relevant Advanced Manufacturing Education Programs

- [Center for Design and Manufacturing Excellence, Automotive Research Center](#) – The Ohio State University
- [CNC Advanced Manufacturing Technologies](#) - Great Oaks Career Campuses
- [Dept of Engineering; Advanced Manufacturing Lab](#) - Otterbein University
- [Dept of Engineering](#) - Lorain County Community College
- [Electro-Mechanical Engineering Technology](#) – Columbus State Community College
- [Manufacturing Skills and Continuing Education](#) - Butler Tech
- [Manufacturing Engineering Technology](#) - Sinclair Community College
- [Programmable Logic Controllers Certificate](#) - Eastern Gateway Community College
- [Robotics, Automation and Design Program](#) - Delaware Area Career Center

EV-Relevant Advanced Manufacturing Industry Credentials

- [American Welding Society – Certified Welder](#) - Various (high concentration in Northeast Ohio and Southwest Ohio)
- [Certified Manufacturing Associate Credential](#) – The Ohio State University, Youngstown State University
- [FANUC Certified CNC Machining and Robotics Credential](#) – Ramtec of Ohio
- [Manufacturing Skill Standards Council Certified Production Technician](#) – Eastern Gateway Community College
- [National Center for Construction Education + Research \(NCCER\) Core Certification](#) – Various (high concentration in Southwest Ohio)
- [NCUS Tech](#) – National Center for Urban Solutions

EV-Hirable Credentials

The list below describes EV-hirable credentials offered in Ohio. This report defines EV-hirable credentials as those most likely to qualify a candidate for an EV position.

- Accelerated Logix 5000 Maintainer Certificate Level 1
- Accelerated Logix 5000 Programmer Certificate Course Level 1
- Allen Bradley / Rockwell Automation PLC
- American Society for Quality (ASQ) Certified Quality Inspector
- American Welding Society (AWS) - Certified Welder (FCAW)
- American Welding Society (AWS) - Certified Welder (GMAW)
- American Welding Society (AWS) - Certified Welder (GTAW)
- American Welding Society (AWS) - Certified Welder (SMAW)
- American Welding Society (AWS) – Welding Qualification (FCAW)
- American Welding Society (AWS) – Welding Qualification (GMAW)
- American Welding Society (AWS) – Welding Qualification (GTAW)
- American Welding Society (AWS) – Welding Qualification (SMAW)
- American Welding Society (AWS) - Certified Welding Inspector
- Certified Additive Manufacturing - Technician (CAM-T)
- Certified Additive Manufacturing Fundamentals (CAM-F) AND Certified Drafter Mechanical
- Electrical Training Alliance Interim Credential
- Fanuc - ArcTool Planning and Operation
- Fanuc - Certified Robot Operator 1 Certification
- Fanuc - Dual Check Safety V7.50 & Newer
- Fanuc - Electrical Maintenance with R-30iB Controller
- Fanuc - Handling Tool Operation & Programming J2P-31- IACT Approved
- Fanuc - iRVision Operation and Programming - 2D

- Fanuc - R-2000i Mechanical Disassembly/Reassembly
- FANUC Certified CNC Machining Center Programming, Setup, and Operation
- FANUC Certified CNC Turning Center Programming, Setup, and Operation
- Haas CNC Lathe Operator
- Haas CNC Mill Operator
- International Society of Certified Electronics Technicians (ISCET) Certified Electronics Technician
- IPC J-STD-001
- KUKA KORE Robot Programming and Operation Certification
- Manufacturing Skill Standards Council (MSSC) - Certified Production Technician (Maintenance Awareness)
- Manufacturing Skill Standards Council (MSSC) - Certified Production Technician (Manufacturing Processes & Production)
- Manufacturing Skill Standards Council (MSSC) - Certified Production Technician (Quality Practices & Measurement)
- Manufacturing Skill Standards Council (MSSC) - Certified Production Technician (Safety)
- Manufacturing Skill Standards Council (MSSC)-Certified Logistics Technician
- Motoman DX100 Basic Programming w/Material Handling (IACET Approved)
- MSSC CPT Plus Skill Boss
- National Institute for Certification in Engineering Technologies (NICET) Level II Certification or Higher
- NC3/Festo - Certified Industry 4.0 Associate - Fundamentals
- NC3/Festo - Fundamentals of Electricity-AC
- NC3/Festo - Fundamentals of Electricity-DC
- NC3/Festo - Fundamentals of Fluid Power-Hydraulics
- NC3/Festo - Fundamentals of Fluid Power-Pneumatics
- NC3/Festo - Fundamentals of Industry 4.0
- NC3/Festo - Fundamentals of Mechanical Systems
- NC3/Festo - Fundamentals of PLC
- NC3/Festo - Fundamentals of Robotics
- NC3/Festo - Fundamentals of Sensor Technology
- NC3/Festo - Introduction to Mechatronics
- NC3/Greenlee Professional Tools – 3-Phase Sequencing and Motor Rotation
- NC3/Greenlee Professional Tools – Advanced Conduit Bending
- NC3/Greenlee Professional Tools – Basic Conduit Bending
- NC3/Greenlee Professional Tools - Cable Pulling
- NC3/Greenlee Professional Tools - Electrical Branch/Series Level Wire Termination
- NC3/Greenlee Professional Tools - Electrical Service Level Wire Termination
- NC3/Greenlee Professional Tools - Hand Bending
- NC3/Greenlee Professional Tools - Insulation and Ground Rod Resistance Testing
- NC3/Greenlee Professional Tools - Wire Pathways: Knockout
- NC3/Greenlee Professional Tools - Wire Pathways: Rotary
- NC3/Lincoln Electric - Introduction to Flux Cored Arc Welding (FCAW)
- NC3/Lincoln Electric - Introduction to Gas Metal Arc Welding (GMAW)
- NC3/Lincoln Electric - Introduction to Gas Tungsten Arc Welding (GTAW)
- NC3/Lincoln Electric - Introduction to Shielded Metal Arc Welding (SMAW)
- NC3/Lincoln Electric - Welding Safety
- NC3/Lincoln Electric Principles of Welding
- NCCER Level 1 - Electrical
- NCCER Level 1 - Heavy Equipment Operations
- NCCER Level 1 - Industrial Maintenance Mechanic
- NCCER Level 2

- NIMS Machining Level 2 Certification
- NIMS: Basic Hydraulic Systems, Basic Mechanical Systems, Basic Pneumatic Systems
- NIMS: CNC Lathe Operations
- NIMS: CNC Lathe Programming Setup & Operations
- NIMS: CNC Mill Operations
- NIMS: CNC Mill Programming Setup & Operations
- NIMS: Drill Press I
- NIMS: Electrical Systems, Electronic Control Systems, and Process Control Systems
- NIMS: Grinding I
- NIMS: Job Planning, Benchwork & Layout
- NIMS: Maintenance Operations, Maintenance Piping, Maintenance Welding
- NIMS: Measurement, Materials & Safety
- NIMS: Milling I
- NIMS: Turning I (Between Centers)
- NIMS: Turning I (Chucking Skills)
- Siemens PLC
- Smart Automation Certification Alliance (SACA) - Certified Industry 4.0 Associate I – Basic Operations
- Smart Automation Certification Alliance (SACA) - Certified Industry 4.0 Associate II – Advanced Operations
- Smart Automation Certification Alliance (SACA) - Certified Industry 4.0 Associate III – Robot System Operations
- Smart Automation Certification Alliance (SACA) - Certified Industry 4.0 Associate IV – IIoT, Networking and Data Analytics
- Smart Automation Certification Alliance (SACA) - Certified Industry 4.0 Automation Systems Specialist I - Electric Motor Control Systems I
- Smart Automation Certification Alliance (SACA) - Certified Industry 4.0 Automation Systems Specialist I - Electrical Systems I
- Smart Automation Certification Alliance (SACA) - Certified Industry 4.0 Automation Systems Specialist I - Variable Frequency Drive Systems I
- Smart Automation Certification Alliance (SACA) - Electrical System Installation I
- Smart Automation Certification Alliance (SACA) - Ethernet Communications I
- Smart Automation Certification Alliance (SACA) - Industry 4.0 Total Production Maintenance Management
- Smart Automation Certification Alliance (SACA) - Mechanical Power Systems I
- Smart Automation Certification Alliance (SACA) - Motor Control Troubleshooting I
- Smart Automation Certification Alliance (SACA) - Pneumatic Systems I
- Smart Automation Certification Alliance (SACA) - Programmable Controller Systems I
- Smart Automation Certification Alliance (SACA) - Programmable Controller Troubleshooting I
- Smart Automation Certification Alliance (SACA) - Robotic System Operations I
- Smart Automation Certification Alliance (SACA) - Robotic Systems Integration I
- Smart Automation Certification Alliance (SACA) - Sensor Logic Systems I
- Smart Automation Certification Alliance (SACA) - Smart Factory Systems I
- Smart Automation Certification Alliance (SACA) - Smart Sensor & Identification Systems I
- Studio 5000 Logix Designer Level 1: ControlLogix Fundamentals and Troubleshooting
- Studio 5000 Logix Designer Level 2: Basic Ladder Logic Programming
- Universal Robotics Core Training

* This list of programs is for illustrative purposes and is not collectively exhaustive of all the EV-relevant educational programs offered by Ohio institutions.

EV-Relevant Apprenticeship Programs

| All EV-Hirable ODRC Apprenticeship Programs Offered in Ohio | # of Programs Offered | All EV-Relevant ODRC Apprenticeship Programs Offered | # of Programs Offered |
|---|-----------------------|--|-----------------------|
| Electrical Maintenance | 15 | Maintenance Repairer, Building | 23 |
| Welder, Combination | 9 | Recover Operator | 21 |
| Quality Control Inspector | 5 | Auto Mechanic | 6 |
| Machine Operator | 5 | Powerhouse Mechanic | 2 |
| Welder, Fitter | 5 | Small Engine Mechanic | 1 |
| Machine Setter | 4 | | |
| Quality Control Tech | 4 | | |
| Assembly Technician | 3 | | |
| Sheet Metal Worker | 3 | | |
| Stationary Engineer | 3 | | |
| Electronic Tech | 4 | | |
| Welder | 2 | | |
| Drafter Detail | 2 | | |
| Drafter | 1 | | |

EV-Relevant and EV-Hirable Correctional Institution Programs

The list below describes the EV-relevant and EV-hirable apprenticeship programs offered by Ohio's Correctional Institutions as of March 2023, based on programmatic data provided by the Ohio Department of Rehabilitation and Correction. EV-hirable programs are those that are most likely to qualify a candidate for an EV position. EV-relevant programs are preferred by EV employers but will not necessarily lead to EV employment. Across all Ohio institutions, 118 apprenticeship programs are offered that are related to EV-relevant occupations.

| Region | County | # of EV-Relevant or EV-Hirable ODRC Apprenticeship Programs |
|-----------|------------|---|
| Central | Marion | 16 |
| | Madison | 14 |
| | Pickaway | 11 |
| | Fairfield | 6 |
| | Franklin | 5 |
| | Union | 2 |
| Southeast | Ross | 13 |
| | Belmont | 3 |
| | Noble | 1 |
| | Scioto | 1 |
| Northeast | Richland | 8 |
| | Lorain | 7 |
| | Trumbull | 4 |
| | Ashtabula | 3 |
| | Cuyahoga | 2 |
| | Mahoning | 1 |
| Southwest | Warren | 15 |
| Northwest | Allen | 2 |
| | Lucas | 2 |
| Western | Montgomery | 2 |

Appendix C: EV, Battery, and EVSE Occupations

| Occupational Title | Description, Relevancy to EV, and Importance | Education Needed for Entry | Specialized Training or Certifications | Sample EV-Specific Job Titles |
|---|---|-----------------------------------|---|---|
| Process Engineer | <p>Designs and optimizes the manufacturing processes used to create materials and components used in EVs, battery module production, and EVSEs.</p> <p>Lead role in resolving assembly related concerns; ensures compliance to plant, corporate, government, and environmental standards; designs processes to scale part, battery, component prototypes into production while considering cost, performance, safety, productivity, manufacturability, and quality.</p> <p>This occupation will become particularly relevant as manufacturing moves to Industry 4.0 and continuous improvement processes are made, particularly to digitization.</p> | Bachelor's Degree | Six Sigma Green Belt Certification (mid-level) | <ul style="list-style-type: none"> - Battery Cell Process Engineer - Process Control Technician |
| Quality Engineer / Quality Associate | <p>Ensures manufactured products meet specified standards and requirements and identifies quality improvement actions throughout the product lifecycle.</p> <p>Tests random samples of finished products; reports manufacturing process deviations; liaises with quality assurance team to resolve issues; oversees mechanical and electrical quality issues.</p> <p>This occupation is relevant both for component and part manufacturing and for overseeing the commissioning of new battery manufacturing</p> | High school diploma or equivalent | <p>Building Performance Institute (BPI) Quality Control Inspector (QCI) certification preferred, not required</p> <p>Certified Energy Manager (CEM)</p> | <ul style="list-style-type: none"> - Battery Cell Component Quality Inspector - Quality Control Inspector - Quality Assurance Specialist |

| Occupational Title | Description, Relevancy to EV, and Importance | Education Needed for Entry | Specialized Training or Certifications | Sample EV-Specific Job Titles |
|--|--|---|---|--|
| | plants. These occupations will particularly boom at the start of the EV transition as many parts and technologies are new to the industry. | | credential preferred, not required | |
| Electrical + Electronic Equipment Assembler | <p>Assembles finished electronic products + component parts.</p> <p>While many electrical components are too small or fragile for human assembly and are assembled by robots and automated equipment, assemblers will fit larger components together as the parts move through the production line. Assess blueprints; solders, assembles, welds parts together based on schematics and assembly instructions.</p> <p>While their focus is on electronic equipment (assembling electrical control devices, electric motors + sensor, etc.), they closely interface with mechanical assemblers, as well.</p> | <p>High school diploma or equivalent</p> <p>Some require postsecondary Technical Degree (Mechatronics, Electronics)</p> | <p>- Fabricators + Manufacturers Association International (FIMA) certifications for fabrication, soldering, coil processing, etc. are preferred, not required</p> <p>- Association for Connecting Electronics Industries (IPC) certifications for electronic assembly and solder are preferred, not required</p> | <p>- Team Assembler</p> <p>- EV Product Fabricators</p> |
| Electrical and Electronic Engineering Technologist + Technician | <p>Applies electrical and electronic theory, usually under the direction of engineering staff, to design, build, repair, calibrate, and modify electrical components, circuitry, controls, and machinery.</p> <p>While electrical engineers focus on electrical circuitry to run primary vehicle functions, electronic technicians are primarily focused on electric control systems and components within a vehicle.</p> | Associate's, Technical Degree | - Multiple relevant NIMS credentials (e.g., Measurement, Materials + Safety) preferred, not required | <p>- Battery Technician, Battery Service Technician</p> <p>- Robotics Technician</p> <p>- Electrical</p> |

| Occupational Title | Description, Relevancy to EV, and Importance | Education Needed for Entry | Specialized Training or Certifications | Sample EV-Specific Job Titles |
|--|--|-------------------------------|--|---|
| | | | | Maintenance Technician |
| Procurement / Sourcing Specialist | <p>Provides the supply base, sourcing strategy, and material supply security to deliver EV and battery business plans.</p> <p>Facilitates purchasing from outside suppliers; negotiates purchase agreements, researches and identifies new suppliers, maintains supplier relations and network. Responsible for tracking/planning orders and confirming accuracy of orders against PO.</p> <p>Growth in demand for already limited raw materials, like cobalt and lithium, that are needed for battery manufacturing, will require innovative sourcing strategies to insulate companies from shortages or price spikes. Looking into alternative battery technologies, like solid-state batteries, or alternative sourcing channels is important in a supply-constrained raw material market.</p> | Bachelor's Degree | -- | <ul style="list-style-type: none"> - Supply Manager, Battery Raw Materials - Battery Pack Purchasing Manager - Buyer - Category Manager |
| Equipment Maintenance Technician | <p>Oversees maintenance of equipment on production lines ensuring minimal downtime and optimal performance.</p> <p>Documents equipment improvement and modifications; routinely inspects and maintain equipment; installs + repairs electrical and mechanical equipment; conducts preventative maintenance on machines + tools; installs and aligns new equipment.</p> <p>As OEMs retool existing plants and create new ones, equipment maintenance technicians are critical in ensuring facility operations and repair. They often balance installation, alignment, and balancing of new equipment with existing building maintenance and upkeep.</p> | Associate's, Technical Degree | - OSHA Certified Forklift Operator preferred, not required | <ul style="list-style-type: none"> - Electrical Maintenance Technician - Machine Mechanic - Equipment Manufacturer - Manufacturing Assembler - Mechanical Manufacturing Assembler - Manufacturing |

| Occupational Title | Description, Relevancy to EV, and Importance | Education Needed for Entry | Specialized Training or Certifications | Sample EV-Specific Job Titles |
|---|---|-----------------------------------|---|--|
| | | | | Engineer (vertical advancement) |
| Robotics Engineer | <p>Responsible for programming, debugging, maintaining, and troubleshooting autonomous and manual robotic solutions used throughout manufacturing supply chain.</p> <p>Researches, designs, develops, or tests robotic applications; operates computer-controlled machines to perform mechanical or electrical functions; assists in setting up machinery for specific operations; downloads firmware and upgrades to machinery; assists in machine troubleshooting and software related errors.</p> <p>While EV's have less parts overall as compared to ICE vehicles, their components tend to be more complex and heavier (namely due to the battery). Suppliers and OEMs are adding new robots to their portfolio to deliver increased productivity, performance, and uptime for EV applications incl. battery module pickings and placing, high precision assembly, and parts handling.</p> | Bachelor's Degree | - Certifications are specific to manufacturer (e.g., FANUC certification) | <ul style="list-style-type: none"> - Computer-controlled Machine Tool Operators (entry-level) - Computer Numerical Control (CNC) Operator - Robotics Technician (entry-level) |
| Production Worker (incl. Production Supervisor, Production Operator) | <p>Ensures production flow and is responsible for assembly, machinery, quality checks, and tool changes of equipment and processes.</p> <p>Responsible for proper functioning of assembly lines and operation of machinery; conducts routine quality checks; general maintenance and cleanliness of facility.</p> | High school diploma or equivalent | <ul style="list-style-type: none"> - Manufacturing Skill Standards Council (MSSC) Certified Production Technician (CPT) - OSHA 10 | <ul style="list-style-type: none"> - Production Associates - Production Technician - Production Engineer (vertical advancement) |

| Occupational Title | Description, Relevancy to EV, and Importance | Education Needed for Entry | Specialized Training or Certifications | Sample EV-Specific Job Titles |
|-------------------------------------|--|----------------------------|--|--|
| Systems Engineer | <p>Authors functional and nonfunctional requirements for software and hardware engineers to develop against; ensures all the sub-units work together as a system.</p> <p>Designs and implements model-based calculations and simulations; translate functional and nonfunctional requirements into written system requirements and architecture to be used by hardware and software developers for design and validation.</p> <p>Systems engineers can be specialized to a specific EV-part domain (e.g., inverter, onboard controller, or battery). They are involved in co-authoring test scripts, capturing + analyzing test data, and developing models for efficient product development. These roles are critical in battery + EV product validation and lifecycle analysis of OEM + Tier 1 products.</p> | Bachelor's Degree | | <ul style="list-style-type: none"> - Inverter Systems Controller - Requirements Engineer - Functional Safety Engineer - Cybersecurity Engineer |
| Automation Controls Engineer | <p>Assists in programming automated processes within electrical and mechanical control systems (e.g., maintenance + fault diagnosis, installation and field instrument modifications).</p> <p>Responsible for day-to-day operation of production line equipment; creates and executes controls test plans for automated process equipment for deployment into production; debugs and optimizes automated processes to reduce cycle time; maximizes machinery availability and improve yield.</p> <p>Advanced manufacturing equipment and systems are highly computerized and connected; knowledge in the software and standards that control these machines is critical in a changing, digitized manufacturing world.</p> | Bachelor's Degree | -- | <ul style="list-style-type: none"> - DevOps Engineer |

| Occupational Title | Description, Relevancy to EV, and Importance | Education Needed for Entry | Specialized Training or Certifications | Sample EV-Specific Job Titles |
|--------------------------------------|--|---|--|---|
| Industrial Production Manager | <p>Improve EV + battery manufacturing quality and efficiency by measuring and analyzing the design, integration, and operation of production systems, including hardware, software, and human capital.</p> <p>Ensures production goals for output and quality are met and within budget; oversees day-to-day operations on plant floor. May oversee entire plant or an area within a plant.</p> <p>As part of the new energy economy, Industrial Production Managers solve problems to increase quality and efficiency in the manufacturing of EV and EVSE related parts. They observe machines on trial runs or conduct computer simulations to ensure programs and machinery are functioning properly. They coordinate assignments and maximize worker performance, machine capacity, and production schedules.</p> | Associate's, Degree Technical Degree | Industrial Manufacturing Technician (IMT) apprenticeship preferred, not required | - Industrial Engineer |
| Electrical Engineer | <p>Researches, designs, develops, tests or supervises the manufacturing of electrical equipment, components, or systems for private, public, commercial, industrial use.</p> <p>Electrical engineers tend to be more involved in the development and design phases of EV and electrical system development, but they are necessary during testing and overseeing of the manufacturing process, as well. In addition to new product development, they also assist with repairs on existing equipment.</p> | Bachelor's Degree | - Professional Engineer (PE) licensure (high-level) | - Facilities Electrical Engineer |
| Chemical Engineer | <p>Oversees the chemical process, design + implementation of the battery cell creation and recycling process.</p> <p>Supports operation by providing technical feedback of chemistry</p> | Bachelor's Degree | <p>- OSHA-30 preferred, not required</p> <p>- Professional</p> | - Chemist (vertical advancement; additional |

| Occupational Title | Description, Relevancy to EV, and Importance | Education Needed for Entry | Specialized Training or Certifications | Sample EV-Specific Job Titles |
|----------------------------|---|-----------------------------------|---|--|
| | <p>fundamentals. Ensures quality control of outputs. Liaises with chemists and material scientists on new battery materials and properties.</p> <p>Cell formats, chemistries, and integration levels (modules, packs, racks) are constantly evolving and have not quite industrialized. Gigafactories today generally consist of a single manufacturing line, which are streamlined for production of a single cell type. However, this is a dynamic market with constantly evolving and potentially disruptive battery innovations.</p> <p>Battery materials are key for successful differentiation of electrochemical energy storage devices (incl. batteries), for which chemical engineering skills are core.</p> | | Engineer (PE) licensure (high-level) | education) - Chemical Process Engineer |
| Recycling Operator | <p>Responsible for operating and monitoring battery and cell recycling processes and knowledgeable on battery material properties (particularly for use in second-life applications).</p> <p>Ensures safety and waste standards are adhered to; proper disposal/handling of waste and scrap material.</p> <p>Through IIJA, \$200B has been allocated to EV battery recycling. Reducing dependence on price-volatile and foreign-owned raw materials (cobalt, copper, nickel) is cornerstone to the bill; promotion of a circular economy and the harvesting of materials from end-of-life-batteries is key to creating a sustainable and economic EV and battery supply chain.</p> | High school diploma or equivalent | DOT's Hazardous Materials Safety Permit | - Cell Recycling Operator - Hazardous Waste Transporter |
| Mechanical Engineer | Provides technical expertise with respect to manufacturing, testing, machine performance, installation, and product operation in field testing. | Bachelor's Degree | Professional Engineer (PE) licensure (high-level) | - Design, Product, or Equipment |

| Occupational Title | Description, Relevancy to EV, and Importance | Education Needed for Entry | Specialized Training or Certifications | Sample EV-Specific Job Titles |
|---|--|----------------------------|--|--|
| | <p>Provides design engineering for EV-related equipment and products; ensures mechanical accuracy of all design documentation; develops hardware specifications to meet customer-specific requirements.</p> <p>Mechanical engineering duties are similar between ICE and EV variants as they primarily work on devices + modules shared between both (e.g., transmissions, drivetrains, steering).</p> | | | <p>Engineer</p> <ul style="list-style-type: none"> - Thermal Engineer - E-powertrain Engineer |
| Environmental, Health, Safety (EHS) Technician | <p>Interfaces with operations, maintenance, and others to grow culture of safety and compliance with federal, regional, and local standards and regulations.</p> <p>Maintaining worker-safety and health during the extraction, processing, and recycling phases was underscored in IJIA's American Battery Material Initiative and recent negative news regarding worker safety on EV production lines has led to increased emphasis on maintaining high environmental, social, and labor standards.</p> <p>This is a particularly growing occupation in battery recycling as electrical safety practices for handling and disassembling of LIB's has been previously understudied and underregulated; increased volumes now entering the secondary market has created a need for these occupations.</p> | Bachelor's Degree | - OSHA 10, OSHA 30 certification | <ul style="list-style-type: none"> - Safety Engineer - Regulatory Compliance Specialist |
| Software Engineer | <p>Design and create software; apply theories of computer science and mathematical analysis to create and evaluate software solutions.</p> <p>Integrates next generation solutions (e.g., 3D, X-ray solutions) to highlight software defects. Modern vehicles, particularly EVs, contain upwards of 10 million lines of code.</p> | Bachelor's Degree | -- | <ul style="list-style-type: none"> - Embedded Software Architect - Cloud Architect - Embedded |

| Occupational Title | Description, Relevancy to EV, and Importance | Education Needed for Entry | Specialized Training or Certifications | Sample EV-Specific Job Titles |
|-------------------------|--|---|--|--------------------------------|
| | Software engineers also provide knowledge and input on software architecture (considering safety, efficiency, capability, quality trade-offs) when implementing new features. Software engineers with clean energy, automotive, and sustainability experience and with up-to-date programming language knowledge (e.g., AWS, Google cloud, IoT) is preferred. | | | Systems Engineer |
| Battery Engineer | <p>Designs and implements various battery types and chemistries and is knowledgeable on the characteristics of batteries that lend to specific types of applications (e.g., within a vehicle vs. within a stationary storage unit).</p> <p>The presence of a battery is the key difference between a ICE vehicle and an EV; an understanding of the battery's role in storing and supplying power for the rest of the vehicle's functions is critical. A battery engineer is also familiar with varying cell design within a vehicle.</p> | Master's Degree | | - Battery Application Engineer |
| Electrician | <p>Installs, maintains, operates and repairs electrical power, communication and control systems.</p> <p>Most states require EVSE installers be certified electricians (with an EVITP certification if conducting an EVSE install funded through NEVI).</p> | High school diploma or equivalent, but must complete electrical apprenticeship or equivalent + pass exam to become a certified electrician/journeyman | - EVITP certification - CPO-specific certifications (e.g., Tesla Certified Installer, ChargePoint University) | - EVSE Installer |

| Occupational Title | Description, Relevancy to EV, and Importance | Education Needed for Entry | Specialized Training or Certifications | Sample EV-Specific Job Titles |
|--|---|-----------------------------------|--|--|
| Electrician Technician / Electrician Helper | <p>Electrician helpers work closely with certified electricians to perform routine electrical work (e.g., cutting and bending conduit and wires, cleaning and assessing sites, adhering to safety protocols).</p> <p>While certified electricians are needed for EVSE install, Electrician Helpers will commission, maintain, repair, and operate EVSEs. They are responsible for conducting hardware and software commissioning of stations, conducting onsite repairs, servicing faulty chargers, and maintaining station performance and reliability.</p> <p>Of note, professionals from the oil + gas industry are great candidates for EVSE technician roles with their focus on safety and regulations and prior hands-on experience + safety awareness in operating commercial equipment.</p> | High school diploma or equivalent | <p>For Technicians working on L2 chargers:</p> <ul style="list-style-type: none"> - NFPA 70 Certificate (Standards for Electrical Safety in the Workplace) - OSHA-10 certificate - Lock Out Tag Out (LOTO) - Job Hazard Analysis (JHA) <p>Additional certifications for technicians working on DCFC:</p> <ul style="list-style-type: none"> - OSHA-30 certificate - High voltage safety training <p>SAE + ChargerHelp! will come out with a credential summer of '23</p> | <ul style="list-style-type: none"> - EVSE Technician - EVSE Operator |
| Urban + Regional Planner | Identifies optimal locations for charging infrastructure and identifies barriers to adoption (e.g., insufficient supporting infrastructure) and urban equity factors. | Master's Degree | - Certification from American Institute of Certified Planners | -- |

| Occupational Title | Description, Relevancy to EV, and Importance | Education Needed for Entry | Specialized Training or Certifications | Sample EV-Specific Job Titles |
|---|---|---|--|-------------------------------|
| | <p>Assists in ensuring NEVI funded stations adhere to FHWA standards of access, reliability, and convenience. Familiar with regional permitting and accessibility requirements</p> <p>Ohio has been allocated \$20.7M annually in NEVI formula funds to create an EVSE network across the state. Urban + Regional Planners will play a critical role in determining EVSE deployments and site needs for upgrades, redundancy, increases in capacity, freight movement, public transit needs, and local/state/federal policy considerations over the 5-year administration of NEVI formula funding</p> | | | |
| Automotive Service Technician + Mechanic | <p>Inspects, maintains, and repairs ICE, electric, and hybrid vehicles.</p> <p>Performs basic car maintenance and repair.</p> <p>The nature of vehicles today has led to an evolution from mechanical repairs to high-level technology-related and electrical-related work. Integrated electronic systems and complex onboard modules regulate vehicles and their performance on the road. Fixing problems with these systems requires workers use computerized shop equipment and work with electronic components as well as traditional hand tools.</p> | Associate degree or Postsecondary nondegree award | <ul style="list-style-type: none"> - Automotive Service Excellence (ASE) Certification - Proprietary OEM-specific certifications (e.g., Tesla START) | -- |

Appendix D: Competencies

| Personal Effectiveness Competencies | | | |
|---|---|---|---|
| Adaptability and Flexibility | Dependability and Reliability | Initiative | Integrity |
| Interpersonal Skills | Lifelong Learning | Personal Acceptability | Professionalism |
| Academic Competencies | | | |
| Basic Computer Skills | Communication | Critical + Analytical Thinking | Writing |
| Mathematics | Reading | Science + Technology | |
| Workplace Competencies | | | |
| Teamwork | Business Fundamentals | Checking, Examining, and Recording | Client/Stakeholder Focus |
| Creative Thinking and Problem Solving | Personal Health and Safety | Planning and Organizing | Scheduling and Coordinating |
| Seeking and Developing Opportunities | Sustainability | Working with Tools and Technology | |
| Advanced Manufacturing Sector-Wide Technical Competencies | | | |
| Business, Legal and Public Policy | Design and Development Lifecycles | Foundations of Engineering | Quality Assurance |
| Maintenance, Installation, and Repair | Operations Management | Process and Equipment Health, Safety, and Environment | Production in the Supply Chain/Supply Chain Logistics |
| EV Industry Technical Competencies | | | |
| Industrial Automation | Field Devices | Controls | System Safety + Reliability |
| Performance Management and Decision Support | Digital Networks | Electrical | Mechanical |
| Batteries and Electrochemistry | Electric Vehicles (EV) and Electric Vehicle Supply Equipment (EVSE) | | Fundamentals of Energy + Power |

Appendix E: Completions Data

Ohio EV-Related Completions by In-Demand Occupation

The following tables display the 2021 completions data from NCES' IPEDS database.⁵³ Completions were derived by mapping education programs by CIP code to the U.S. Department of Labor's occupation classification SOC code. IPEDS data can only be used for higher education programs - therefore, EV occupations that are not associated with higher education pathways are not captured in this analysis. For information about supply for these career pathways, see Apprenticeship and Industry-Recognized Completions (Recycling Operator, Production Worker, and Electrical & Electronic Equipment Assembler).

| In-Demand Occupation | Total Graduates | U.S. Citizen | Diversity | Women |
|---|-----------------|--------------|-----------|-------|
| Industrial Production Manager | 12,118 | 11,538 | 3,410 | 5,713 |
| Software Engineer | 5,290 | 4,004 | 1,111 | 1,159 |
| Systems Engineer | 2,554 | 1,748 | 484 | 634 |
| Mechanical Engineer | 2,123 | 1,775 | 268 | 372 |
| Electrical and Electronic Engineering Technologists and Technicians | 1,274 | 1,221 | 283 | 148 |
| Robotics Engineer OR Automation Controls Engineer | 1,219 | 1,045 | 205 | 332 |
| Electrical Engineer | 1,159 | 800 | 185 | 193 |
| Automotive Service Technician and Mechanic | 929 | 926 | 258 | 49 |
| Chemical Engineer | 850 | 676 | 134 | 310 |
| Process Engineer | 832 | 672 | 164 | 199 |
| Electrician Technician / Electrician Helper | 372 | 339 | 72 | 40 |
| Urban and Regional Planner | 316 | 274 | 90 | 152 |
| Procurement / Sourcing Specialist | 222 | 220 | 25 | 69 |
| Electrician | 131 | 131 | 9 | 6 |
| Environmental, Health, Safety (EHS) Technician | 62 | 60 | 14 | 33 |
| Equipment Maintenance Technician | 38 | 37 | 12 | 4 |
| Quality Engineer / Quality Associate | 5 | 5 | 0 | 1 |
| Total | 25,629 | 22,599 | 5,969 | 8,568 |

The total completions number across all in-demand occupations will not equal the summation of the completions associated for all In-Demand Occupations since some CIP codes are associated with multiple In-Demand Occupations. Additionally, this total includes all Ohio completions in addition to completions from community colleges, 4-year institutions, and OTCs.

⁵³ Emsi Burning Glass (now Lightcast) (2023), "[Full School Listing](#)," Lightcast – lightcast.io

Ohio EV-Related Completions by Institution and Institution Type

| Four-Year Institutions | Total Graduates | U.S. Citizen | Diversity | Women |
|---|-----------------|--------------|-----------|-------|
| University of Cincinnati-Main Campus | 2,099 | 1,552 | 308 | 653 |
| The Ohio State University-Main Campus | 2,395 | 1,854 | 580 | 617 |
| Ohio University-Main Campus | 1,259 | 1,195 | 213 | 430 |
| Franklin University | 852 | 825 | 456 | 376 |
| Cleveland State University | 876 | 702 | 178 | 305 |
| University of Dayton | 1,085 | 643 | 106 | 303 |
| Wright State University-Lake Campus | 124 | 124 | 5 | 280 |
| University of Toledo | 942 | 762 | 155 | 254 |
| Kent State University at Kent | 671 | 586 | 128 | 230 |
| Bowling Green State University-Main Campus | 573 | 525 | 65 | 223 |
| Case Western Reserve University | 746 | 533 | 184 | 198 |
| Miami University-Oxford | 617 | 499 | 88 | 155 |
| University of Akron - Main Campus | 714 | 621 | 123 | 151 |
| Ashland University | 327 | 275 | 77 | 141 |
| Ohio Christian University | 184 | 182 | 75 | 108 |
| Youngstown State University | 439 | 359 | 61 | 100 |
| The University of Findlay | 180 | 164 | 35 | 85 |
| University of Cincinnati-Blue Ash College | 193 | 191 | 61 | 73 |
| Xavier University | 226 | 223 | 43 | 69 |
| Walsh University | 135 | 123 | 46 | 65 |
| University of Northwestern Ohio | 613 | 597 | 183 | 63 |
| John Carroll University | 142 | 136 | 11 | 57 |
| Air Force Institute of Technology-Graduate School of Engineering & Management | 405 | 396 | 100 | 55 |
| Wright State University-Main Campus | 848 | 731 | 161 | 53 |
| Mount Vernon Nazarene University | 142 | 142 | 32 | 51 |
| Ohio Dominican University | 104 | 95 | 42 | 49 |
| University of Cincinnati-Clermont College | 135 | 135 | 19 | 48 |
| Baldwin Wallace University | 117 | 117 | 22 | 40 |
| Heidelberg University | 82 | 80 | 9 | 38 |
| Central State University | 75 | 64 | 62 | 33 |
| Capital University | 80 | 73 | 19 | 31 |
| Wilmington College | 60 | 60 | 18 | 30 |
| Tiffin University | 83 | 71 | 21 | 30 |
| Otterbein University | 85 | 85 | 22 | 29 |
| Malone University | 80 | 80 | 8 | 24 |
| Kent State University at Tuscarawas | 74 | 72 | 9 | 23 |
| Miami University-Hamilton | 101 | 100 | 23 | 20 |
| Mount Saint Joseph University | 51 | 51 | 7 | 20 |
| Lourdes University | 47 | 47 | 18 | 20 |
| Shawnee State University | 44 | 44 | 2 | 18 |

| Four-Year Institutions | Total Graduates | U.S. Citizen | Diversity | Women |
|--|-----------------|--------------|-----------|-------|
| University of Cincinnati-Main Campus | 2,099 | 1,552 | 308 | 653 |
| The Ohio State University-Main Campus | 2,395 | 1,854 | 580 | 617 |
| Ohio University-Main Campus | 1,259 | 1,195 | 213 | 430 |
| Franklin University | 852 | 825 | 456 | 376 |
| Cleveland State University | 876 | 702 | 178 | 305 |
| University of Dayton | 1,085 | 643 | 106 | 303 |
| Wright State University-Lake Campus | 124 | 124 | 5 | 280 |
| University of Toledo | 942 | 762 | 155 | 254 |
| Kent State University at Kent | 671 | 586 | 128 | 230 |
| Bowling Green State University-Main Campus | 573 | 525 | 65 | 223 |
| Case Western Reserve University | 746 | 533 | 184 | 198 |
| Miami University-Oxford | 617 | 499 | 88 | 155 |
| University of Akron - Main Campus | 714 | 621 | 123 | 151 |
| Ashland University | 327 | 275 | 77 | 141 |
| Ohio Christian University | 184 | 182 | 75 | 108 |
| Youngstown State University | 439 | 359 | 61 | 100 |
| DeVry University-Ohio | 57 | 57 | 22 | 17 |
| Franciscan University of Steubenville | 70 | 70 | 8 | 16 |
| Bluffton University | 44 | 42 | 10 | 16 |
| Cedarville University | 110 | 109 | 14 | 15 |
| Bryant & Stratton College-Parma | 22 | 22 | 9 | 14 |
| Kent State University at Trumbull | 21 | 21 | 1 | 14 |
| University of Mount Union | 44 | 43 | 5 | 13 |
| Muskingum University | 39 | 38 | 7 | 12 |
| Ohio University-Chillicothe Campus | 26 | 25 | 2 | 9 |
| Notre Dame College | 31 | 30 | 9 | 9 |
| Ohio Wesleyan University | 28 | 28 | 8 | 9 |
| Ohio Northern University | 71 | 71 | 20 | 8 |
| Hiram College | 33 | 31 | 13 | 8 |
| Ohio University-Lancaster Campus | 14 | 14 | 0 | 8 |
| Union Institute & University | 9 | 9 | 2 | 6 |
| The College of Wooster | 13 | 7 | 2 | 6 |
| Denison University | 18 | 10 | 4 | 6 |
| Marietta College | 14 | 13 | 1 | 5 |
| Miami University-Middletown | 26 | 24 | 3 | 5 |
| The Ohio State University-Lima Campus | 8 | 8 | 2 | 5 |
| Oberlin College | 39 | 33 | 7 | 5 |
| Kent State University at Ashtabula | 11 | 11 | 1 | 5 |
| Herzing University-Akron | 9 | 9 | 3 | 5 |
| Kent State University at Salem | 5 | 5 | 1 | 4 |
| The North Coast College | 4 | 4 | 2 | 4 |
| Wittenberg University | 21 | 20 | 2 | 3 |
| Wilberforce University | 9 | 9 | 9 | 3 |
| Antioch University-Midwest | 6 | 6 | 2 | 3 |
| Ohio University-Southern Campus | 7 | 7 | 0 | 3 |

| Four-Year Institutions | Total Graduates | U.S. Citizen | Diversity | Women |
|--|-----------------|--------------|-----------|-------|
| University of Cincinnati-Main Campus | 2,099 | 1,552 | 308 | 653 |
| The Ohio State University-Main Campus | 2,395 | 1,854 | 580 | 617 |
| Ohio University-Main Campus | 1,259 | 1,195 | 213 | 430 |
| Franklin University | 852 | 825 | 456 | 376 |
| Cleveland State University | 876 | 702 | 178 | 305 |
| University of Dayton | 1,085 | 643 | 106 | 303 |
| Wright State University-Lake Campus | 124 | 124 | 5 | 280 |
| University of Toledo | 942 | 762 | 155 | 254 |
| Kent State University at Kent | 671 | 586 | 128 | 230 |
| Bowling Green State University-Main Campus | 573 | 525 | 65 | 223 |
| Case Western Reserve University | 746 | 533 | 184 | 198 |
| Miami University-Oxford | 617 | 499 | 88 | 155 |
| University of Akron - Main Campus | 714 | 621 | 123 | 151 |
| Ashland University | 327 | 275 | 77 | 141 |
| Ohio Christian University | 184 | 182 | 75 | 108 |
| Youngstown State University | 439 | 359 | 61 | 100 |
| Defiance College | 18 | 18 | 2 | 3 |
| Ursuline College | 3 | 3 | 1 | 3 |
| The Ohio State University-Newark Campus | 11 | 11 | 3 | 3 |
| The Ohio State University-Mansfield Campus | 9 | 9 | 1 | 2 |
| The Ohio State University-Marion Campus | 4 | 4 | 0 | 1 |
| Kent State University at Geauga | 3 | 3 | 1 | 0 |

| Community College | Total Graduates | U.S. Citizen | Diversity | Women |
|--|-----------------|--------------|-----------|-------|
| Eastern Gateway Community College | 1,550 | 1,550 | 650 | 1,015 |
| Sinclair Community College | 1,341 | 1,291 | 389 | 458 |
| Columbus State Community College | 859 | 849 | 311 | 33 |
| Stark State College | 359 | 359 | 70 | 97 |
| Cuyahoga Community College District | 345 | 331 | 121 | 78 |
| Lorain County Community College | 312 | 306 | 82 | 131 |
| Cincinnati State Technical and Community College | 189 | 174 | 77 | 72 |
| Owens Community College | 176 | 172 | 43 | 64 |
| Terra State Community College | 151 | 151 | 27 | 40 |
| Edison State Community College | 136 | 136 | 11 | 75 |
| Lakeland Community College | 133 | 133 | 17 | 60 |

| Community College | Total Graduates | U.S. Citizen | Diversity | Women |
|------------------------------------|-----------------|--------------|-----------|-------|
| James A Rhodes State College | 112 | 112 | 9 | 49 |
| Zane State College | 107 | 107 | 10 | 38 |
| Marion Technical College | 91 | 91 | 13 | 251 |
| North Central State College | 84 | 84 | 6 | 52 |
| Clark State Community College | 77 | 77 | 22 | 42 |
| Central Ohio Technical College | 64 | 63 | 15 | 40 |
| Washington State Community College | 51 | 51 | 4 | 18 |
| University of Rio Grande | 49 | 48 | 8 | 22 |
| Northwest State Community College | 46 | 45 | 14 | 12 |
| Southern State Community College | 21 | 21 | 1 | 14 |
| Belmont College | 15 | 15 | 3 | 4 |
| Hocking College | 13 | 12 | 2 | 2 |

| Ohio Technical Center | Total Graduates | U.S. Citizen | Diversity | Women |
|--|-----------------|--------------|-----------|-------|
| Butler Technology and Career Development Schools | 25 | 25 | 3 | 1 |
| O C Collins Career Center | 21 | 21 | 0 | 1 |
| Polaris Career Center | 19 | 19 | 6 | 3 |
| Mid-East CTC-Adult Education | 18 | 18 | 4 | 1 |
| Miami Valley Career Technology Center | 17 | 17 | 0 | 0 |
| Apollo Career Center | 14 | 14 | 3 | 2 |
| EHOVE Career Center | 12 | 12 | 0 | 2 |
| Great Oaks Career Campuses | 12 | 12 | 9 | 0 |
| Scioto County Career Technical Center | 12 | 12 | 0 | 1 |
| Pickaway Ross Joint Vocational School District | 11 | 11 | 0 | 2 |
| Eastland-Fairfield Career and Technical Schools | 10 | 10 | 6 | 0 |
| Madison Adult Career Center | 10 | 10 | 0 | 0 |
| Buckeye Hills Career Center | 9 | 9 | 0 | 0 |
| Portage Lakes Career Center | 6 | 6 | 6 | 0 |
| Ashland County-West Holmes Career Center | 6 | 6 | 1 | 0 |
| Mahoning County Career and Technical Center | 5 | 5 | 3 | 0 |
| Canton City Schools Adult Career and Technical Education | 4 | 4 | 3 | 0 |

| Ohio Technical Center | Total Graduates | U.S. Citizen | Diversity | Women |
|------------------------------------|-----------------|--------------|-----------|-------|
| Trumbull Career & Technical Center | 2 | 2 | 0 | 0 |